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## Contents

| | PAGE |
|---|---|
| The Impasse | 385 |
| Steel and Cast Iron for Civilian Use | 386 |
| Correspondence | 386 |
| Vitamin A in the Enamelling Industry | 386 |
| Notes from the Branches | 386 |
| Random Shots | 386 |
| Brake Drums | 387 |
| A Study of One cause of Casting Defect | 389 |
| Hydrogen in Steel | 389 |
| Institute of British Foundrymen | 390 |
| Fettling Analysed | 391 |
| A New Foundry Equipment Works | 392 |
| A Post-War Hint for the Foundry Industry | 392 |
| Foundry Problems | 393 |
| American Standard Alloy Steel Listed | 396 |
| U.S. Iron and Steel Output | 396 |
| De-Oxidation in the Foundry Cupola | 398 |
| An Estimation of Silicon in Monel Metal | 398 |
| The Week's News in Brief | 400 |
| Trade Talk | 400 |
| Personal | 400 |
| Obituary | 400 |
| New Companies | 400 |
| Contract Open | 400 |
| Reports and Dividends | 400 |
| Raw Material Markets | 402 |

## The Impasse

About 1924, we wrote in this column an editorial headed "A Commercially-voiceless Industry," which created quite an uproar in foundry circles. As a consequence we were invited to meet the Council of the National Ironfoundry Employers' Federation with the object of developing our views. These were very cordially received, and the friendly contact then established has been cemented by the passing of years. Many in the inner councils of that body endorsed our programme of expansion so as to allow of the admission of all types of ironfoundries, with the object of making it truly national in scope. In the years just prior to this war, much progress was registered. In collaboration with the British Ironfounders' Association and a few other bodies, the now famous Pig-Iron Rebate Scheme was carried through. These meetings presented a splendid opportunity for closer collaboration in other fields, but there was no true appreciation of a community of interests other than pig-iron purchase. It was then hoped to use this as a lever to strengthen the structure of the existing associations, but in autumn, 1939, apparently some of the foundries not attached to any foundry employers' association met at York with the hope of creating a body which would weld all employers' interests whether federated or not, in order that contact could be made with Government departments for the dual purpose of the better prosecution of the war and the safeguarding of the interests of the foundry industry as a whole. From this the Ironfounders' National Committee, later to be called Confederation, was born. There was immediate recognition of this body in Government circles, but coincidently bickering broke out. Much time was lost in preparing elaborate articles of association, and too much energy devoted to the search for the empirical establishment of economic price levels. Support was accorded by existing organisations on the express condition that nothing should be done to weaken the fabric of these bodies. The I.N.C. never received real nation-wide support, and consequently there was inadequate financial strength. The climax was reached over matters of high policy, and a resolution was carried for the disbanding of the Confederation. To put this into effect a postal vote was taken, and although 65 per cent. of those voting endorsed the resolution, it cannot thereby be carried into effect because the Articles of Association require that before any such action can be taken, 75 per cent. must vote, a figure far from realisation. We are not sure that apathy was entirely the reason for the small vote, as certain associations sent letters to their members, suggesting how they should vote, and obviously created feelings of mixed loyalties. This has resulted in the creation of a situation of extreme complexity, rendered even more complex, if possible, by the rumour that certain people who have not so far taken any major part in these activities are seeking to establish an organisation on new bases. All these extraordinary happenings tend to underline the necessity for the immediate establishment of not only a nationally representative body, but also one possessing real authority, a factor not properly conceded so far. Whether the I.N.C. in altered form, the N.I.E.F., the well-organised B.I.A., or the new interests referred to assume responsibility for cementing the various interests into one concrete body, we care not, but something must be done quickly. Most people were surprised when last Sunday week they found that clothing had been rationed. Foundry interests may be equally astonished to find one morning that telescoping is to be applied to their industry. Every piece of recent major legislation has had its impact on the foundry industry, and its lack of organisation has created delays in co-ordinated representation. Of war measures there have been the A.R.P. regulations; insurance of stocks; food rationing in relation to heavy duty workers; installation of canteens; reserved occupations; insurance under the War Damage Act; the wartime building regulation schedules; the purchase tax, and, most recently, rationed clothing. Recognition has been accorded by the authorities for the exemption of moulders' boots from the purchase tax, because it is conceded that they are a measure of protection against burns. This establishes that in foundries burning is a hazard likely to be encountered, and its effect on clothing should be taken cognisance of in the using up of coupons. Even in the chemical laboratory two accidents in the same week could reduce the wardrobe of a routine chemist to very meagre proportions. Obviously there must be an industrial emergency ration. Thus it is shown that for most of the emergency measures enacted by the Government, there are impacts on the industry, which require co-

*(Continued on page 386, col. 3.)*

## Steel and Cast Iron for Civilian Use

Authorisations for the acquisition of steel for home civilian requirements, hitherto licensed by the Iron and Steel Control, Ministry of Supply, under Symbol B.T.2, will in future be authorised by the Board of Trade, to whom applications for Form M for this purpose should now be sent, addressed to the Assistant Secretary, Industrial Supplies Department, Board of Trade, Millbank, London, S.W.1.

Application should in general be made by the manufacturers of goods containing steel and not by the purchasers; separate application forms must be completed for steel required for the repair and maintenance or extension of plant, and the tonnages required for this purpose must not be included in applications for steel for the production of manufactured articles.

The Iron and Steel Control will continue to issue licences for iron castings and for high-speed steel containing 14 per cent. or more of tungsten. Applications for licences to obtain iron castings should, therefore, still be made in duplicate on form S.C.11/K to the Controller of Iron and Steel, Iron Castings Section, Ministry of Supply, Ripley, Derbyshire, and those for high-speed steel in duplicate on Form S.C.4/0 to the Controller of Iron and Steel, Ministry of Supply, Ashorne Hill, near Leamington Spa, Warwick. Applications for tinplate, terneplate and black plate should continue to be made by the actual fabricators only to the Administrator of Tinplate Distribution, 50, Charing Cross, London, S.W.1. The tonnages of these finished steel products should not be included in applications made to the Industrial Supplies Department, nor should steel used in ball and roller bearings and precision chains.

For a short time there will still be a few other purposes for which Iron and Steel Control licences will be issued under the Symbol B.T.2. Any application for steel for such purposes received by the Board of Trade will be forwarded to the Iron and Steel Control.

## Correspondence

*[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]*

*To the Editor of* THE FOUNDRY TRADE JOURNAL.

**Melting Borings**

SIR,—Reading Mr. W. Slingsby's short letter (Melting Borings), I think it is quite a good practice, and should be given much more serious thought, and I am sure it would be a worthwhile national effort, as well as showing a commercial profit, in which matter I thoroughly agree with Mr. Slingsby. We should all give the subject a little more thought, and get it into practice without delay. I seriously wonder how many of our aluminium foundries follow this practice, and what tonnage of this material is wasted quite unconsciously. Let us get down to this matter without delay.—Yours, etc.,

A. E. LENG.

Sheffield.

*To the Editor of* THE FOUNDRY TRADE JOURNAL.

**Steel or Cast-Iron Pipes?**

SIR,—We notice that a number of municipalities are still calling for supplies of steel pipes. In one recent case the demand was for 9 miles of 18-in. diameter material. Surely under the present circumstances it would be in the national interest that cast-iron pipes should be used.—Yours, etc.,

FOUNDRYMAN.

**Iron Ore in Bihar and Orissa**

In a brochure, "The Stratigraphy of South Singhbhum," DR. J. A. DUNN, of the Geological Survey of India, deals with the stratigraphical aspects of the area, and produces evidence to show that a regrouping of the area is necessary to distinguish the true iron-ore series occurring in the lower and older group of strata which contains the main iron ore deposits, from the relatively newer Kolhan Series occurring in the upper group of strata.

## Vitamin A in the Enamelling Industry

In speaking before the annual convention of the Institute of Cooking and Heating Appliance Manufacturers recently in Cincinnati, Ralph F. Bisbee, supervisor of quality control at Westinghouse's merchandising division, Mansfield, O., told how quality control develops the use of widely separated devices to improve products and reduce selling prices. By feeding vitamin A to workmen, more than $5,000 a year for the past three years was saved through reduction of the number of "off-colour" parts in assembling electric ranges.

Good example of the results of quality control is the reduction of rejects on the assembly line due to mismatched colours in the assembly of doors within the frames of electric ranges. Improved seeing conditions, the result of a so-called "tunnel of light" which has mercury-vapour indirect lighting, giving 200 foot-candles intensity at the tunnel's middle, was one of the more important items which helped reduce colour mismatching rejects from more than 3 per cent. to an average of 1.7 per cent. during the 12-year period ending in 1935.

Desiring still further reduction, it became evident that the personal equation played a vital part in this problem. Investigation disclosed that the sensitivity of the human eye is dependent on the changes that take place in a substance called "visual purple," which is contained in the eye's retina. In order for the eye to maintain its sensitivity, the amount of this visual purple substance changed must be continually replaced, or regenerated. It was this fact that paved the way for the entrance of vitamin A therapy, for it was found that if the rate of regeneration of visual purple is below normal, the use of vitamin A therapy will bring it up to, or higher than, normal in almost every case.

With this retinal fatigue preventive, the seeing accuracy of the inspectors was improved to such a degree that rejects on the assembly line have now been reduced from the 1935 average of 1.7 per cent. to an average of only three-tenths of 1 per cent. for the last 36 months.—"Steel."

## Notes from the Branches

*East Midlands Section.*—The next meeting is to be held on Saturday, June 14, at the Crown and Anchor Hotel, Ipswich, when Mr. George Hall is to give his Presidential Address. After the tea interval, there is to be a discussion of matters of topical interest.

THE COUNCIL OF THE INSTITUTE OF WELDING have nominated all the existing officers for re-election for a further period of office.

## Brake Drums

(*Continued from page* 388.)

certain conditions does improve the wear-resisting qualities and, providing the phosphide can be obtained in minute enough form, particularly in the centrifugally-cast type of drum, it is believed that it may have certain advantages. A brake-drum iron showing a full phosphide network is depicted in Fig. 7.

*Free Cementite.*—In a relatively coarse form the presence of this constituent is considered undesirable. Hard spots result on machining and scoring difficulties follow. The presence of cementite also causes rapid and uneven wear of the lining since the softer pearlite matrix wears away, leaving the hard cementite in relief to act as a cutting tool (see Fig. 8).

(*To be continued.*)

## Random Shots

The very definite effort which is being made by the Ministry of Home Security to ensure that all large reserves of water, whether public or privately owned, shall be made available to local fire brigades, recalls an amusing reminiscence of the very earliest days of A.R.P. work. In those less hectic times the volunteer firemen of Manchester used to spend an evening or two each week frolicking in the Manchester Ship Canal. The condition on which they were allowed to practise with the canal water was that they put it back again!

* * *

Local councils may well wonder at times what they will do with all their A.R.P. tackle after the war, but it is felt that, at any rate, there will be a brisk demand amongst night club proprietors for "All Clear" and "Alert in Progress" signboards.

* * *

It now behoves all men to see that their umbrella does not develop a cauliflower-topped ferrule for the duration. No longer will it be deemed sufficient to apologise to the charming young lady who catches her stocking in it whilst stepping into the train. Nor yet will offers of monetary compensation set the mind and conscience at rest. In fact, nothing would suffice but that one take out ration book on the spot and cut out for her a couple of margarine coupons; and bang goes that new scarf, pair of gloves, or mittens!

* * *

A smart epigram from an American journal says that "the real humorists of this country (America) are the zanies who design hats for women."

* * *

In England, too, they are the only zanies left in the clothing trade who can still laugh at life.

* * *

Were a prize to be offered for subtlety in advertising, it would surely go to the Society of Brewers, who bought "blue sky" in the "dailies" and presented it to the Ministry of Information to further the Save Water Campaign.

* * *

Mrs. Malaprop came in very excited the other morning because she hopes to see her soldier son soon. "He is trying to get seven days' passionate leave in order to get married," she announced. "But what I'll do about a wedding tea I really don't know," she went on. "They'll have to do without a wedding cake, that's all, and feast off nectar and ammonia like the gods."

* * *

This week's best crossword clue is a sample of French gone mad, and comes from the "Sunday Times":—

*Clue.*—Ûátè.

*Answer.*—Accentuate.

"MARKSMAN."

(*Concluded from page* 385.)

ordinated representation to ensure proper adjustment. Only recently we gave our interpretation on the insurance of customers' patterns under the War Damage Act, but should have felt happier if the question could have been answered by the legal expert of some really national body. As to how this association is to emerge from the present impasse we cannot imagine, but much more statesmanship will have to be shown than has been evident in the past.

# Brake Drums*

## GREY CAST IRON AND MEEHANITE

By OLIVER SMALLEY, O.B.E.

Basically a brake drum is part of a mechanism that converts energy of motion into heat. The amount of heat generated and the speed of dissipation of this heat are, therefore, the main factors that determine the life of any brake drum. They are factors which, theoretically, appear simple of analysis and calculation, yet practically are bewildering in their complexities.

The three major requirements that must be considered in the selection of a material for brake drum manufacture are initial cost, performance, and service life.

FIG. 1.—BRAKE-DRUM IRON WITH 12.13 TONS TENSILE AND BRINELL HARDNESS 174. (MAG. 1,000.)

FIG. 2.—BRAKE-DRUM IRON WITH 13.85 TONS TENSILE AND BRINELL HARDNESS 187. (MAG. 1,000.)

### Initial Cost

This cost must have direct relation to the expected overall service life. It is for this reason that materials such as steel, both low and high carbon; combinations of light alloys or steel-back with a cast-iron ring, and all cast-iron drums have found general favour, for while they present certain shortcomings their low initial cost presents obvious advantages.

### Performance

Performance covers design, heat-dissipation, coefficient of friction, type of wear surface developed, and general maintenance of drum form during its operating life. In service a brake-drum has to take care of the bulk of the energy converted into heat through conduction, convection, and radiation regardless of design. With the high speeds and quicker stops of the modern vehicle in service under varying conditions of weather, this is presenting an ever increasing problem to both the metallurgist and the engineer. Unfortunately, theoretical formulæ for calculation of heat flow and temperature, while possible for laboratory tests, are most difficult to interpret to road service. It is known that the wear of a brake drum is not necessarily simple mechanical disintegration, for electron-diffraction studies reveal that there may be an actual fusion of the brake drum surface. This is far-reaching in its implications, for while many students of brake drums like to report on brake drum temperatures as approximating 200 deg. C. and sometimes reaching 650 deg. C., actually the contacting surface is always considerably higher, and more often than not the immediate backing layer will exceed the higher figure.

Any laboratory study of the physical properties of a brake drum material at ordinary temperature conditions, therefore, has little meaning so far as wear is concerned, and is unlikely to be of any help except under conditions where braking is of the mildest type. Immersion pyrometer tests are of themselves also misleading, for any examination of the surface of a brake drum after ordinary service will show structural changes that could only have taken place at much higher temperatures than those recorded.

It is unfortunate that in these days of scientific enlightenment modern metallurgists should know not only so little about such questions as to what actually "*wear*" is, but that they should possess so little fundamental knowledge on the behaviour of common cast iron and steel at elevated temperatures and, for that matter, on the physico-chemical properties of cast iron and steel at temperatures likely to be encountered in brake drum service.

It is known in a general way that the coefficient of thermal conductivity of both cast iron and steel falls rapidly with an increase in temperature, but exact figures for the various kinds of common steels and cast iron are not available. Metallurgists satisfy themselves by saying that steel has approximately 22 per cent. greater conductivity than cast iron. but as almost every grade of cast iron has a different thermal conductivity this does not mean too much.

In a general way there is also available some knowledge of the specific heat of both steel and cast iron at elevated temperatures, but even this simple property has not been established positively. Something is known of the creep strength of certain cast irons and mild steel at the lower temperatures, yet nothing is known of their fatigue or endurance properties at elevated temperatures or the effect of varying conditions of temperature change. After all, the stress encountered in a brake drum is not only a complex dynamic stress at elevated temperatures, but is one of rapidly changing intensity accompanied by drastic temperature changes. Much has been done to attempt to correlate Brinell hardness of a brake drum with its service life and wear-resisting properties, yet there is little or no knowledge of how the Brinell hardness varies under temperature influence or what the Brinell hardness of the actual wearing surface of the brake drum is likely to be in service.

Some idea of what is involved in this regard is shown by the following tests (Table I) made on certain brake drum irons at room temperature and at 650 deg. C. The figures of Table I were obtained on each specimen after holding at the temperature indicated for one hour. Just what the readings would indicate after several heatings and also after long periods of heating is not shown, but the above tests do show clearly that consideration of Brinell hardness at room temperature is one thing and that at the temperature of the drum in service is another.

FIG. 3.—BRAKE-DRUM IRON WITH 15.6 TONS TENSILE AND BRINELL HARDNESS 217. (MAG. 1,000.)

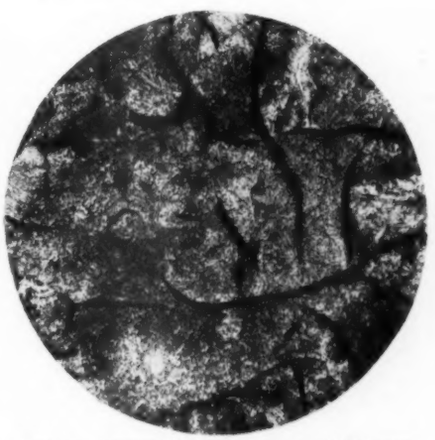

FIG. 4.—BRAKE-DRUM IRON WITH 18.75 TONS TENSILE AND BRINELL HARDNESS 237. (MAG. 1,000.)

TABLE I.—*Effect of Temperature on Brinell Hardness Numbers of Various Brake Drum Cast Irons.*

| Composition. | | | | | | | | B.H.N. | | Cold after heating to 650 deg. C. |
|---|---|---|---|---|---|---|---|---|---|---|
| T.C. | Si | Mn | S | P | Ni | Cr | Mo | At 20 deg. C. | At 650 deg. C. | |
| 3.26 | 1.64 | 0.73 | 0.111 | 0.102 | — | — | — | 217 | 107 | 207 |
| 3.40 | 1.77 | 0.73 | 0.072 | 0.112 | — | — | — | 217 | 123 | 223 |
| 3.26 | 1.92 | 0.86 | 0.098 | 0.108 | 1.31 | 0.25 | — | 248 | 121 | 241 |
| 3.48 | 1.89 | 0.94 | 0.140 | 0.107 | — | — | 0.75 | 235 | 152 | 235 |

* A paper read before the (American) Society of Automotive Engineers.

### Structure

Many studies have been made by various authorities of brake drum materials attempting to prove that this or that microstructure is essential for long service life. A too commonly made statement is that a "*pearlitic structure*" is essential to good wear and to avoid scoring of cast-iron brake drums. This, unfortunately, is also another somewhat meaningless expression, for pearlite itself is not a simple structure, and the matrix of almost any cast iron poured into light brake drums is mostly pearlitic in one form or another; yet it is certain that everybody is agreed that just any sort of cast iron is not the right material for all brake drums. Examples of four brake-drum irons exhibiting so-called "*pearlitic structure*" are shown in Figs. 1 to 4, with a linear but comparable reduction.

It has been stated that high duty irons of 18 to 22 tons tensile should be used on brake drums where it is desirable to save weight. Such statements again are meaningless, for it is questionable whether tensile strength of itself conveys anything on the performance of a brake drum. Actually, existing knowledge of both the metallurgy and mechanical properties of brake drum materials is, at the best, both superficial and scanty.

Returning to the main problem of the brake drum, which is converting work into heat, it is known that in the severe service of the modern drum, heat is often generated much faster than it can be dissipated, and also that this may happen more times than the drum can withstand without developing serious and objectionable defects. For the most part, these defects usually take the form of scores and thermal cracks.

### Scoring

On first consideration, the cause of scoring in brake drums appears obvious. A particle of sand or foreign material finds its way into the brake mechanism, and locating on the surface of the brake lining is all that is needed to start a cutting action under the pressure of braking. Each of the small particles of metal so removed will also become imbedded in the brake lining and act individually as cutting tools by removing more and more from the surface of the brake drum—a process which is cumulative until the drum is badly worn and the lining cut up and loaded with metal.

The three examples in Fig. 5 are typical of this kind of scoring in city bus drums, involving high-speed stops at frequent intervals. This, unquestionably, is one cause of scoring, but both the brake mechanism, the material from which the drum is made, and the condition of the drum may have quite an important influence on scoring. Drum distortion causing extremely high pressures over localised areas is a common cause of scoring. A too abrasive type of brake lining, or a lining that is harder than the drum, or a lining that wears in powdery form, or other conditions of the lining that cause cutting of the drum surface will result in scoring.

The remedy for this is obvious, and first consideration should be given to proper selection of lining to drum material or drum material to lining, but in either case the nature of the service and the design of the drum are also factors which cannot be ignored. Dragging brakes, failure to release brake pressure immediately after the stop is completed, and unnecessarily abrupt stops are important contributing factors.

A common cause of scoring is overheating, but a drum scored because of overheating does not necessarily display thermal checks, for the surface may wear away almost as fast as the checks are formed, and often only a close examination will reveal minute thermal cracks.

*Material.*—The remedy of scoring through overheating may lay in the selection of an iron with larger quantities and a better distribution of graphite in a harder matrix or in the use of a softer lining or a better design of brake mechanism. Scoring in waves or grooves is often an indication of free patches of ferrite in the microstructure of the drum (Fig. 6). The presence of this constituent always tends to reduce wear, cause pick-up and galling, and end in uneven wear.

The use of irons containing over 0.4 per cent. of phosphorus are thought to favour scoring on account of the tendency of the particles of the hard friable phosphide to fall loose from the base metal and becoming imbedded in the lining: however, the presence of phosphorus under

(*Continued on page* 386.)

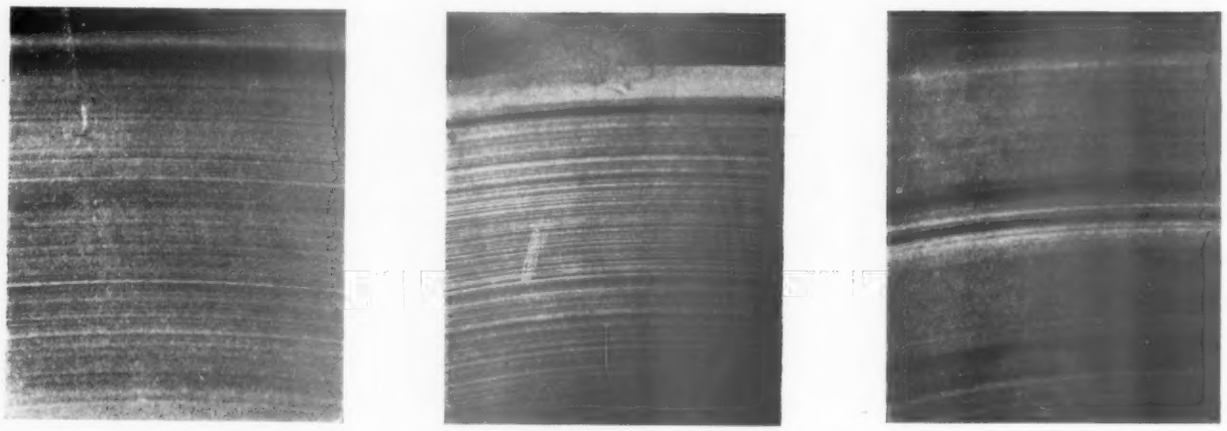

FIG. 5.—THREE EXAMPLES OF SCORING ON CITY BUS DRUMS, DUE TO SURFACE ABRASION BY FOREIGN PARTICLES.

FIG. 6.—FREE PATCHES OF FERRITE IN MICROSTRUCTURE. (MAG. 1,000 BUT REDUCED.)

FIG. 7.—BRAKE-DRUM IRON SHOWING FREE PHOSPHIDE NETWORK. (MAG. 1,000 BUT SLIGHTLY REDUCED.)

FIG. 8.—EXPOSURE OF FREE, HARD CEMENTITE. (MAG. 1,000 BUT REDUCED.)

# A Study of One Cause of Casting Defects*

By ARTHUR S. KLOPF, Chicago, Ill.

Machine tool castings, because of the great amount of time spent in machining the inside as well as the outside of the casting, suffer more from sub-surface defects than any other type of casting.

Periodic reoccurrence of the defects, shown in Bars D and F of Fig. 1, occurred in castings received from two foundries, which were always satisfactorily replaced, but the cause of which was never studied to completion. A low carbon iron, in the range carbon 3.00 to 3.10 per cent.; silicon, 1.90 per cent.; manganese, 0.85 per cent.; phosphorus, 0.18 per cent.; and sulphur, 0.12 per cent. was used with no alloy added. The tensile strength was approximately 18 tons per sq. in., and the Brinell number approximately 200.

### Causes of Defect

Inasmuch as it is a recognised fact that an iron of the above type is far more sensitive to mould conditions, than an ordinary iron, the writer felt that the condition shown was due to either wet facing, or green ladles, coupled with dull iron; that is, iron poured at a temperature too low for this type of iron. These castings, ranging up to 100 lb. in weight, were poured in green sand moulds, made on squeezer, or small jolt roll-over machines.

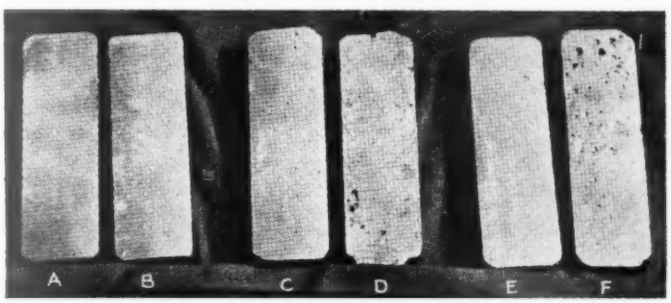


FIG. 1.—TEST-BARS MADE FOR REVEALING CASTING DEFECTS DUE TO MOULD CONDITIONS.

A representative section of the castings was then agreed on, which was a bar 1½ in. by 1¼ in. by 6 in. With the bar attached to the pattern in question, so that it would be poured as a unit under exact conditions, many test castings with bars were made and then machined, ⅛ in. being removed from the top and bottom. The results are shown by the six bars in the accompanying illustration. Each bar shown is the average for its group.

### Individual Analysis

Bar A was made in a mould, using relatively dry facing, poured from a dry ladle, and of hot iron. The bar was quite clean and free from any defects.

Bar B was poured in a mould made with relatively dry facing, from a dry ladle, but with cool iron. Here a few inclusions were found, but no trace of entrapped steam or gases.

Bar C was poured in a mould, made with dry facing, but from a green ladle, of hot iron. The pockets then were evidently caused by the steaming ladle, and there were no entrapped inclusions.

Bar D was poured against relatively wet facing, from a dry ladle of cool iron, and again steam was generated and entrapped in the casting. The number of steam pockets was several times as great as in Bar C; hence, it is evident that wet facing is more serious than green ladles.

Bar E, in contrast to Bar C, was poured in a mould, made with dry facing, from a dry ladle, but with cool iron. It is evident there was practically no steaming, but again inclusions were entrapped by the cool, sluggish iron.

Bar F was poured into a mould made with very wet facing, from a dry ladle of hot iron. From the illustration, it is evident that a tremendous amount of steam was generated which was unable to work through the iron before solidification. The experiments now reached the condition found in the castings that were scrapped in the past.

### Conclusion

From the above, the conclusion was quickly reached that wet facing was the major cause of the condition, although green ladles were very dangerous when all other conditions were ideal. Careful study of sand conditions and effects was then made, after which the proper moisture and permeability were determined and then maintained. With the moisture carefully controlled and using hot iron poured from properly dry ladles thousands of the castings made in the last six months have shown no defects whatsoever.

* From the "American Foundryman," the house organ of the American Foundrymen's Association. The author is vice-president and manager, Foundry Division Hansell-Elcock Co.

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### War Gases

The Ministry of Home Security has issued a reprint of "War Gases: Their nature, effects and first aid treatment," which is a chart embodying a full description of all war gases likely to be used by the enemy, together with their possible effects. A special feature is the inclusion for the first time of a short summary of the appropriate first aid treatment. A.R.P. officers and others in large works, who give gas instruction will find this chart of considerable value. Copies can be obtained from most booksellers, or from the Stationery Office, York House, Kingsway, W.C.2. (Price 3d. post free.)

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(*Continued from previous column.*)

appears that the concentration in electric-furnace charges is lower than that in open-hearth charges. In the coreless induction furnace, the hydrogen in the expelled gases may drop to as low as zero, while equilibrium in the open-hearth is usually reached at between 1 and 3 per cent. The hydrogen take-up from the furnace gases appears to be inhibited more by an acid open-hearth slag than by a basic. Towards the end of the melting period the hydrogen in the expelled gases was usually about 1 per cent. with acid melts, as against 2 to 3 per cent. with the basic melts. In Bessemer and basic processes the hydrogen content roughly corresponds to that determined by the moisture content of the air blown through, *i.e.*, 0.6 per cent. at 0 deg. and 3.1 per cent. at 25 deg. with saturation.

# Hydrogen in Steel

IN the course of researches inquiring into the take-up and expulsion of hydrogen in steel manufacture, reported in a Paper in "Stahl und Eisen" by S. v. HOFSTEN, BO KALLING, F. JOHANSSON and O. KNOS, the conditions affecting the hydrogen content of steel during refining in various steelmaking processes was examined, the fluctuation in the hydrogen content of the expelled gases being carefully followed. These gases were collected by lowering a bell over the steel bath, a pipe above the bell serving for the removal of the gases for analysis. Improved conditions of sampling were later realised by substituting a crucible of graphite for the bell, which made sampling easier and permitted representative samples to be taken over a longer period. The results of the authors' investigations indicate that if the hydrogen content of the gases is known, its amount in the steel can be calculated with the aid of Sieverts value for the solubility of hydrogen in steel. The hydrogen in the steel was also determined directly by the vacuum fusion method, but the agreement between calculated and determined values was not good. The authors believe that the value calculated from the gas samples is perhaps more reliable and gives a better picture of the actual fluctuations in the hydrogen content of the molten steel.

The expulsion of hydrogen from molten steel, which is kept boiling in a hydrogen-free atmosphere, is closely related to the quantity of carbon eliminated in refining a relationship which may be expressed in the form of a curve which the authors designate as the "normal curve." The shape of this curve was established for a series of melts in a coreless induction furnace, high hydrogen values being ensured at the beginning of sampling. Increased solubility of hydrogen at elevated temperatures causes a displacement of the "normal curve" with temperature.

If the furnace atmosphere contains hydrogen or hydrogen compounds, some hydrogen can also be taken up from the furnace gases at the same time as other hydrogen is expelled by the working of the charge. The hydrogen content will then not drop to zero, but approach a certain stationary equilibrium value at which take-up and expulsion take place at equal rates. The carbon content, which has to be reduced to attain this equilibrium, does not apparently have to exceed 0.3 per cent. when the initial hydrogen content is high. Hydrogen take-up from the furnace atmosphere is determined mainly by the hydrogen content of that atmosphere and the protective action of the slag. High temperatures appear to promote the take-up of hydrogen, especially with basic melts. The rate of refining does not appear to affect the take-up.

Hydrogen introduced into the charge by rusty or oily scrap is nearly all expelled again during the melting of the charge. If the carbon is then reduced to 0.2 to 0.3 per cent., the hydrogen content of the charge can no longer influence the hydrogen content of the steel. A considerable amount of hydrogen may be introduced into the steel by other means during refining, for instance, by moistened slaked lime, wet ore, leaky cooling pipes, etc. Hydrogen introduced in this way may result in excessive hydrogen in the finished steel, if decarburisation is not carried far enough after melting. There is some evidence that hydrogen taken up during tapping, *e.g.*, by contact with wet ladle linings or too-heavily tarred moulds, may have a greater effect on the finished steel than that resulting from the reactions in the furnace itself.

As regards the concentration of hydrogen in the various melting processes employed, it

(*Continued at foot of next column.*)

# Institute of British Foundrymen

## ANNUAL MEETING OF THE LONDON BRANCH

Owing to war conditions, the London Branch of the Institute held its annual general meeting rather later this year than usual. It was held on Saturday afternoon, June 7, at the National Liberal Club, Whitehall Place, London, S.W.1, a building which bears the scars of war, its famous staircase having suffered from enemy action.

Mr. C. Barrington Hooper, C.B.E., the retiring Branch-President, presided.

At the opening of the proceedings Mr. V. C. Faulkner, who did so much to establish the Branch on a firm foundation when he served as Hon. Secretary some twenty years ago, and who has since served as President of the Branch and of the Institute, and has again taken over the secretarial duties, announced the receipt of a letter from Mr. Wesley Lambert, C.B.E. (Past-President of the Institute and of the Branch), apologising for his inability to attend the meeting, and congratulating the Branch on having carried on under war-time conditions. Mr. Faulkner recalled his great and best work in the interests of the Branch; and at his suggestion the meeting resolved that a letter of good wishes be sent to Mr. Lambert. A telegram from Mr. J. N. Burns, who is now in Turkey, conveyed the greetings of the sender to the members.

The minutes of the preceding annual general meeting, held on May 8, 1940, were read, confirmed, and signed.

### Hon. Secretary's Report

Mr. Faulkner's report on the work of the Branch for the past year was as follows:—

*Finance.*—The London Branch income at £547 11s. 6d., as against £503 9s. 7d. in 1940, constituted a record, and was the highest amongst all branches. The expenses unfortunately, were very low, at £37 3s. 7d., which reflects the decreased activity of the Branch.

*Technical Progress.*—It should be remembered that the East Anglian Section is part of the London Branch, and here a full technical programme has been carried through, a fact reflecting the greatest credit upon the officers, especially Mr. J. L. Francis, the honorary secretary. London has had but one technical meeting, when Mr. G. H. Meigh presented his Paper on "Aluminium Bronze."

*Social.*—A Christmas luncheon was held at the Constitutional Club. It was quite informal, but served the useful purpose of permitting a much-needed reunion of members. A second luncheon was held in May at the Dorchester Hotel. Over eighty members and guests participated. Sir John Wardlaw-Milne was the principal guest. Judging by the number of extremely appreciative letters received, an outstanding success was acclaimed. For both these functions, the thanks of the Branch are due to the President, who spared neither time nor energy to ensure the happiness and comfort of each individual member.

*Membership.*—There are, at the moment, three hundred and fifty-two names on the London Register. This figure differs from the circularising list, as there are a number of our members living abroad, including several in the Dominions; amongst allied nations, and one or two enemy aliens. The Branch suffered severe losses through death in 1940. The most eminent member was Prof. Sir C. Henry Carpenter, F.R.S., whose tragic death created a void in metallurgical science which will be difficult to fill. Another old member was Mr. Quicke, of Madeira. Though he never attended a Branch meeting, the Branch President took the opportunity of making his acquaintance when on a visit to the island. The third member was Mr. Clavey of Stones. During 1940, in addition to the loss by death, just referred to, there were four resignations and five erasures, due to arrears of subscriptions. New members elected (all grades) numbered fourteen. As transfers to and from the Branch counterbalanced each other, there was a net gain of two. Ten of our members are serving with H.M. Forces.

The reason why the Branch is meeting in this place is well known. Happily, the lantern escaped damage, even though it has been doubly "blitzed."

Owing to Mr. Lockwood's transfer to the Birmingham Branch, a change in the honorary secretaryship took place last February. In taking over this position, acknowledgement is of the wholehearted assistance which has been accorded by Mr. Lockwood; Mr. Hooper, the Branch-President, who largely made himself responsible for the luncheon party; Mr. Bolton, of the General Office; and Mrs. Faulkner. The Council and members have been all too kind in the general expression of their gratitude for this action in re-assuming office. The thanks of the Branch are also due to Mr. J. P. Ellis, the honorary lanternist.

On the motion of Mr. Templeton, seconded by Mr. F. J. Wares, it was unanimously adopted; and an expression of appreciation and thanks was conveyed to Mr. Faulkner for having stepped into the breach and carried on the work of hon. secretary, as well as to Mrs. Faulkner, who had assisted ably in many directions.

### Election of Officers and Council

*Branch President*

The Branch-President, recalling that a year ago he had been asked, in view of war conditions, to continue in office for a second year, hoping for the best, said it appeared that perhaps "the best" was still some distance off. It was felt, therefore, and he fully concurred, that the Branch should now revert to the normal procedure and elect a new Branch-President. The Council and the Past-Presidents of the Branch had nominated Mr. R. B. Templeton for election to that office.

The motion was seconded by Mr. Pincott and carried amid applause.

MR. TEMPLETON, in his response, said that, in view of the invitation of the Council and Past-Presidents of the Branch, he felt bound to accept office, and he hoped he would be able to emulate the activities of Mr. Barrington Hooper. At any rate, he would do his best in the interests of the Institute.

*Branch Vice-Presidents*

It was the recommendation of the Council that Mr. H. W. Lockwood, who had served as Senior Vice-President, but was unable to accept nomination as Branch-President by reason of his temporary transfer to the Midlands, should be asked to retain the office of Senior Vice-President; and it was hoped that in the future it would be possible for him to become Branch-President.

The re-election of Mr. Lockwood as Senior Vice-President was proposed by Mr. Faulkner, who paid a tribute of appreciation of his work for the London Branch, recalling that Mr. Lockwood had served as hon. secretary for a number of years, had relinquished the office to Mr. Daglish before the war, and had resumed when the latter was called to H.M. Forces at the beginning of the war. On his transfer to the Midlands subsequently, Mr. Lockwood had handed over the affairs of the Branch in perfect order.

The proposal was seconded by Mr. C. C. Booth, J.P. (Past-Branch-President) and carried with acclamation. On the proposal of Dr. A. B. Everest (Past-Branch-President), a message of good wishes was sent to Mr. Lockwood, with the expression of the hope that he would be back with the Branch in the near future and would be able to accept the Branch Presidency in due course.

As Junior Vice-President, the meeting unanimously elected Mr. A. J. Murphy, M.Sc.

*Branch Hon. Secretary*

The motion by the chairman, seconded by Mr. Templeton, that Mr. Faulkner be re-elected hon. secretary, was carried with acclamation.

*Members of Council*

Mr. F. J. Cree and Mr. A. C. Turner, who retired from the Branch Council by rotation and were eligible for re-election, were unanimously re-elected.

There were two further vacancies (one of them being due to the elevation of Mr. Murphy to the vice-presidency). To fill those vacancies the meeting elected Mr. F. Arnold Wilson and Dr. L. B. Hunt.

*Auditors*

Mr. Chas. Cleaver was re-elected an auditor, and Mr. V. Delport (Past-Branch-President) was elected an auditor to fill the vacancy caused by the resignation of Mr. A. R. Bartlett, who has left the London area. Thanks were expressed to Mr. Delport for having carried on the duties of an auditor at the end of last year.

*Delegates to General Council*

Mr. C. H. Kain and Mr. C. C. Booth, J.P. (Past-Branch-Presidents), Mr. H. W. Lockwood (Senior Vice-President) and Mr. B. B. Kent were re-elected Branch delegates to the General Council.

*Representatives on Technical Committee*

Mr. C. H. Kain and Mr. Murphy (Junior Vice-President) were re-elected Branch representatives on the Institute's Technical Committee.

### Vote of Thanks

MR. C. C. BOOTH, proposing a vote of thanks to the President and Council of the Branch for the very good work they had done during the past year, which had been one of great difficulty, said that not only had Mr. Barrington Hooper carried out his duties as President very well, but he had also nominated, and the meeting had elected, a very good man to succeed him. He and his colleagues on the Council had indeed served the Branch well.

The vote of thanks was seconded by MR. GENTLES, and carried with enthusiasm.

MR. BARRINGTON HOOPER, responding, paid tribute to the members of the Branch Council for their support, and said he was very sorry indeed that they had not had more to do. He had been looking forward to being able to arrange a year of great activity, had times been normal; but war conditions had made it necessary to modify the arrangements. At any rate, the Institute had been able to put in some good work in connection with the International Foundry Congress, held in London in 1939, and the London Branch had had a good deal to do in connection with it.

Following the formal business of the meeting, MR. A. E. MCRAE SMITH, M.A., presented a Paper in which he dealt with foundry technique for high strength and special duty alloy iron castings, a technique by which 30-ton tensile cast irons were produced using cupola melted metal. (The Paper and the discussion which followed will be dealt with in a future issue.)

# Fettling Analysed*

By CARL A. CARLSON

Castings are submitted to grinding operations to obtain exact dimensions and a well-finished appearance. This group of grinding operations is called "snagging." The castings are ground to remove what is left from gates and risers. In some instances abrasive cutting-off wheels are used to sever gates and risers. Fins and parting lines are ground and rough surfaces are smoothed out. Some castings are also ground to exact dimensions or perfect fit. Foundries have found more and more uses for grinding wheels. The art of making castings is constantly improving but the demands for close dimensions and smooth finish are also more exacting.

### Types of Machines Used

Of the many kinds of grinding machines used, the most common are floor stands and bench stands. Heavy, well-guarded, 30-in. and 24-in. floor stands are used for production grinding on both light and medium sized castings. The machines are equipped with ball or roller bearings and usually gearing is provided to keep the surface speed of the wheels at the most economical level. Smaller floor stands and bench stands are used for finishing operations.

Swing frame machines are used when grinding large castings and also smaller ones when there is a considerable amount of material to be removed. The machines are suspended from a trolley on a jib arm or a small travelling crane. It is important to have swing frame machines that can be handled fast and conveniently. The following wheel diameters are used: 16, 18, 20 and 24 in. Most machines have at least one speed change to prevent the surface speed from reduction below a certain minimum.

Portable grinders are used for smoothing rough surfaces and to remove small defects. The majority of the portable machines are made to use wheels running at 9,500 s.f.p.m. The most popular are the ones with most power per unit of weight. Six or eight-inch diameters and special shaped wheels are used. On some work which can be done within a certain area, flexible shaft grinders are used to advantage.

For work such as grinding pipes internally and finishing heavy castings, a special grinder is used. The grinding wheel is mounted on one end of a long, enclosed spindle, directly driven by a motor on the other end. The machine is suspended from a trolley on a track or from a movable jib arm. For finishing manganese steel, chilled iron and other hard castings, a number of semi-precision grinding machines are used. Some automatic machines are used in foundries where a great number of the same kind of castings are ground.

### How the Work is Handled

Every foundry tries to handle their castings in the most convenient manner. Some are more successful than others. The castings are placed, by crane or carrier, as near the operator as possible. Small castings ground on floor stands are usually dumped in a box which is placed within easy reach of the operator. Medium-size castings ground on floor stands are placed by carrier on a bench at such a height that the operator can remain in a standing position.

Levers are used to obtain necessary pressure for floor stand work. If possible the levers should be fastened to the work rest. In any event they should be attached so they cannot slip from their fulcrum and endanger the workman. Small castings ground with swing frame machines are placed in fixtures, on benches or in sand boxes of convenient height to give the operator a close view of the work. Large castings ground with swing frame machines and handled by crane, are usually placed to grind one casting while others are being turned or taken away.

Portable grinding probably offers the greatest field for improvements. Some smaller castings can be held by vice or fixture. Larger castings can be placed on a turntable to obtain the best angle for machine and operator. In case there are a large number of the same types of castings, they should be handled on a conveyor with each man doing his side or part of the casting.

### Speed Considerations

High-speed wheels have proved successful for practically all steel castings when there are large shrink heads to be ground. On certain railway castings, such as bolsters and couplers, the economical use of high-speed wheels depends upon surrounding conditions.

The cutting grains in high-speed Bakelite-bonded grinding wheels (9,500 s.f.p.m.) are subject to a greater shock than in vitrified wheels running at 6,000 s.f.p.m. For soft and tough castings and non-ferrous metals the grains are hard enough to stay sharp. On hard castings with sharp fins or sandy surface the grains dull more quickly and added pressure will be necessary to make them cut. More speed usually makes the wheels cut faster but on certain materials the abrasive grains will soon dull or fracture.

Some kinds of castings and grinding methods require the wheels to withstand great pressure or shock and the softer Bakelite bond may not be strong enough to hold the grains, and the harder vitrified bond is needed. Manganese steel castings are successfully ground with both high-speed and vitrified wheels. The high-speed wheels usually require less manual effort.

Small malleable castings such as fittings can generally be ground cheaper with high-speed wheels. As high speed causes more grinding heat, there is a chance that some hard malleable castings may develop grinding cracks. In such cases the Crystolon type vitrified wheels operating at lower speeds are preferable. On large, soft malleable castings, which are ground with considerable pressure, the vitrified wheels are both fast and economical.

Grey iron castings are usually ground with No. 37 Crystolon vitrified wheels. Special grades of cast iron, such as used in cylinder blocks for automobiles, are economically ground with high-speed Bakelite wheels. Practically all the non-ferrous metals can be ground faster and cheaper with Bakelite-bonded high-speed wheels.

### Abrasives and Bonds Best Suited to Snagging

Grinding wheels must fit the varied physical properties of castings and different grinding methods. To apply the proper wheels a variety of abrasives, bonds, and processes is available, *e.g.*, regular alundum abrasive grains which are hard and tough, No. 15 Alundum which is more easily fractured, and No. 37 Crystolon which is hard but more brittle. The grain sizes for snagging range from No. 10, the largest, to 24 or 30 on the finer side. Large grains are used when grinding with heavy pressure on a small area of contact. As the pressure decreases on the same area smaller grains are used. The grains should be held strongly enough so that they are not pulled out of the wheel until they become dull and begin to lose their cut so as to be torn out when too dull. Softer wheels are used as the area of contact increases.

Accurate grain spacing (controlled structure) is a means of controlling the number of grains in contact with the work and of obtaining chip clearance. It is conceivable that when grinding castings with hard sharp fins the grains should be packed closer together, and when grinding flat surfaces of soft steel a more open grain spacing is needed.

The type of bond is usually determined by the speed of the wheels, Bakelite for a maximum speed of 9,500 s.f.p.m. and vitrified bond for a maximum speed of 6,000 s.f.p.m. Of the two types of bond there are several variations, each one best adapted for certain classes of work. To help the cutting action and prevent loading several special treatments for the wheels are provided.

### Safety Precautions

Grinding wheels must be handled carefully during transport and in storerooms. Always remember that if a wheel is dropped or falls on its side, a crack may develop. Wheels must not be piled too high, as it may impose too much weight on those at the bottom. The best method is to stand the wheels on edge in a rack built for the purpose.

Before mounting on the machine the wheels should be tapped gently to be sure they have the ring of a sound wheel. Cracks in vitrified wheels can be discovered in this manner. With Bakelite-bonded wheels it will be more difficult to judge the sound, and a close visual examination will be more reliable.

It is essential to make sure that the wheel flanges on the machine are of ample and equal diameters, about half of the wheel diameter for vitrified wheels. Moreover, the face of the flanges must be relieved. When starting the machine, stand away from the wheel until it has run at full speed for a short while. The wheels are speed-tested before being despatched, but rough handling in transit may cause cracks.

When grinding small castings on floor stands, the work rest must be close enough to the wheel and so provide a shield to prevent castings from falling into the wheel guard and breaking the wheel. The wheels must not be run at a higher speed than recommended by the manufacturer. In order to obtain the proper grinding wheel specification, it is best to consult the firm's grinding wheel manufacturer, who can more closely fit the wheel to meet the particular requirements.

* Abstracted from "Grits and Grinds."

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### Exports to South America

Mr. H. S. Mackintosh, a member of Lord Willingdon's mission to South America, gave an address to the Institute of Export recently. After pointing out that the opinions expressed were personal and should not be taken as being the views of the British mission or any other official body, Mr. Mackintosh said that as matters stood to-day a decline in our exports of finished consumer goods must be expected. He said he did not believe that Britain's commercial and financial hold in South America was doomed. Our traditional connections with the Latin American republics, the great British undertakings in those territories and the network of British commercial organisation still existed strongly. But we must alter our trading policy and methods in many industries. It was clear to the Willingdon mission that there had been in the past an insufficiency of British business men from home touring the markets. What was needed was close inspection of these countries by high executives of British firms, who were capable and empowered to take large measures on the spot, who had sound technical knowledge of their own products, and, so far as possible, spoke Spanish and Portuguese (good French would serve instead of the latter). If and where local companies were formed they should be national to the country in which they were situated—not a British company with a board of directors in London.

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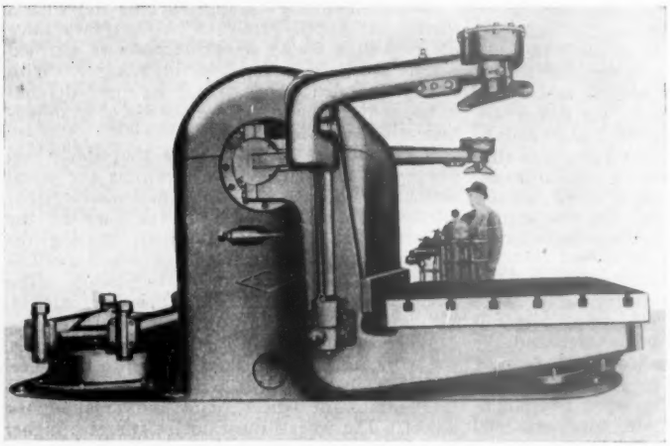
# A New Foundry Equipment Works

## TYPICAL PRODUCTIONS DESCRIBED

It is only a few years ago since the Coleman Foundry Equipment Company, Limited, established themselves as manufacturers, acquiring a works with a floor space of approximately 3,000 sq. ft. At the time it was considered probable that a works of this size would meet the requirements of the company for some years. From the outset the company determined to devote themselves to the production of equipment of the highest quality. Needless to say such machines are not low priced. It is, however, desirable to differentiate between low prices and cheapness, the terms being by no means synonymous. The cost of a machine or tool is a charge against capital, whilst the running cost and maintenance are charged against revenue; these indeed are the items which swell the "On charges" of the works. Initial and maintained efficiency, freedom from breakdown, combined with simplicity of operation, should be the factors determining the choice of a machine for the foundry, and certainly not the initial cost.



THE "COLEMAN" DAVENPORT 12,000-LB. MODEL, POWER JOLT, ROLLOVER, PATTERN DRAW-MOULDING MACHINE.

The specialities of the Coleman Foundry Equipment Company have from time to time been dealt with in our columns, and need not therefore be stressed in this article. The company found, one might almost say, a waiting market for certain of their specialities, such for example as the horizontal core blower and moulding machines, in particular the roll over type. The space available at the existing works was wholly inadequate to meet the demands, and considerable extensions had to be considered. Extensions to the works would, on account of the high values asked for the land, have been particularly costly; further there was the labour problem, and in the locality of the old works there is a definite shortage of suitable labour.

The management were fortunate in finding a more suitable site, where labour is plentiful. The company acquired the freehold of a considerable area of ground, thus making liberal provision for future requirements. In the meantime the works erected cover a floor space of 20,000 sq. ft. Fronted by the general offices and surrounded by well-kept gardens.

The layout of the works is in keeping with its surroundings, roomy airy buildings with ample gangways between machines, etc. The works are not connected up with the railway; in this instance, however, there is no necessity for such connection, as all deliveries are made in the company's lorries and raw material brought in by them. Of the works themselves, there is no need to dwell at any length, generally the equipment is such as one would expect to find in a modern engineering shop. The patternshop, the pattern stores and timber stores occupy an entirely independent site at some little distance from the main works. The equipment of the patternshop is decidedly above the present works requirements, indeed it includes all classes of up-to-date wood-working machinery, the whole being electrically driven.

The foundry is served by a cupola of a melting capacity of 2½ tons per hour; this is blown by a Sirocco fan and served by an electrically driven hoist. The charging platform has a storage capacity of 50 tons of iron. This platform will be common to a second cupola of 3 tons per hour which is now in course of erection. Obviously, in a foundry producing a wide range of single castings mechanisation would be out of the question, thus hand moulding is exclusively employed. The heaviest casting made is approximately 1,200 lbs. and the largest box used 10 ft. by 4 ft. by 4 ft. There is a full complement of pneumatic fettling tools, grinding wheels, etc.

The machine and erecting shop covers a floor space of 11,800 sq. ft., the floor of which is reinforced concrete. The machines comprise lathes, the largest a 3-ft. centre with a 10-ft. bed, milling machines, shapers, boring mills (one of these last will take work up to 12 ft. long by 8 ft. in dia.), drilling machines, planing and grinding machines. Each machine is served with a mono-rail hoist, those over the large machines having a lifting capacity of 2 tons, whilst the lift over the small machines is of 10 cwts. capacity. Benches are ranged along one side of the shop, the tables of the benches are cast-iron plates 6 ft. by 5 ft., which are planed on both sides and carried on brick pillars.

### A Large Moulding Machine

Of the machines passing through the shop at the time of our representative's visit, a "Coleman" Davenport power jolt rollover pattern draw-moulding machine, of the largest standard size manufactured, calls for special mention. A brief specification of the machine is as follows:—Capacity, 12,000 lbs.; pattern plate, 66 in. by 115 in.; flask outside, 72 in. by 130 in.; flask depth, 44 in.; pattern draw, 30 in.; jolt cylinder diameter, 20 in.; floor space required, 94 in. by 120 in. Designed on very liberal lines, with ample rugged strength, this machine represents a very high standard of manufacture. A real engineering job, built, one might say, on the lines of a machine tool and with a very pleasing clean finish.

A universal machine, fast and accurate, with all its working parts totally guarded against the ingress of sand, it embodies three distinct power operated features, *i.e.*, jolting, rolling over and locking and unlocking of pattern plate, equalising and vibrating and clamping of the board to flask, and all air operations controlled from one column. The complete machine is mounted upon single baseplate as a unit ready for installation upon a concrete foundation, thus no pit or pits are needed. In the jolting position the pattern plate rests freely upon the jolt table, but when rolling over commences, it is automatically locked by air-operated locking bars. The rolling over is accomplished by air cylinders.

Whilst rolling over the flask is held securely by the rollover arms which are swung in and clamped to the bottom board, both operations being air-controlled. After the mould is rolled over and the flask rest is raised to position, the four levelling pins contact the bottom board and are locked by air when the mould is level. The flask rest is easily adjustable by air; it is thus a simple matter to change jobs on the machine. The pattern draw is oil-controlled, and the speed of draw is controlled by a regulating valve. When the pattern is drawn the rollover arms are swung clear automatically. The machine is fitted with powerful vibrators and also with a patent non-return valve, so that in the event of a sudden failure in the air supply, the machine is perfectly safe. The illustration conveys a good idea of the robust construction and the general appearance of the machine.

In addition to this very large machine, there were a number of smaller types of the "Coleman" Davenport machines going through the shops. These were size numbers 24 and 28, on machines having tables measuring 24 by 38 in. and 27 by 40 in. respectively. Of standard moulding machines being produced in large quantities was the fast work Type CN jar-ram squeeze pattern draw. It will be remembered that the smallest size of this machine has a 7-in. straight pattern draw.

A type of machine which is growing in popularity is the abrasive cut-off machine of which a large range is made at the Coleman Works. These machines can cut runners and risers so close to the casting and do it so quickly that grinding is reduced to a minimum and expensive non-ferrous alloys are returned to the melting pot without the delays consequent upon prolonged hold-ups in the fettling shop. The range made is particularly wide and includes quite small but efficient bench type machines.

## A Post-War Hint for the Foundry Industry

Every issue of "Drop Forging Topics," the official organ of the [American] Drop Forgings Association, contains this paragraph:

"The Drop Forging Association, through its Technical Staff, welcomes inquiries regarding the advantages of the drop and upset forging process as applied to specific production problems. A large number of inquiries relating to all types of problems were received during the past year. We shall continue to advise every inquirer direct, and in strict confidence.

"If you have a problem relating to forging on which you want authoritative advice—or, if one should arise later—please feel free to consult our Technical Staff, without obligation. Blueprints or actual parts may accompany your inquiry, and they will be returned after they have served the purpose."

The national employers' associations of both the steel and iron sections of the foundry industry might do worse than emulate this service immediately the war is over.

# Foundry Problems

## PIPES AND FORMING-DIE PRACTICE

At a meeting of the Lancashire Branch of the Institute of British Foundrymen, held in the Engineers' Club, on April 5, a discussion took place upon "Foundry Problems." Mr. W. Holland, Branch-President, was in the chair.

The discussion was opened by MR. A. SUTCLIFFE (Bolton), who made free use of diagrammatic sketches on the blackboard in order to show how to run pipes of any size and shape. Some, he explained, were run on the top, and he was of opinion that this method gave the best result on test for pipes up to 12 in. dia., though it was not a good system to strike-up the core in more than one operation. He emphasised that by striking-up two or three times in such pipes, the top shell would lift and float about if run on the top.

Nowadays the holes in flanges were mostly drilled, but in coring up flanges it was often observed that the foundrymen used a sprig in order to keep the flange cores in position, when cast. This was not necessary if the cores were "jammed" on each side.

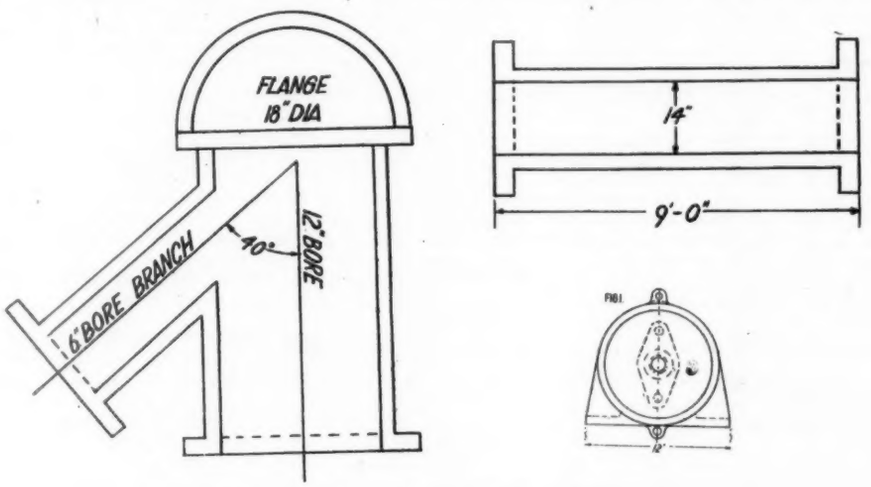



FIG. 1.—SKETCHES OF PIPE MOULDING METHODS.

Mr. Sutcliffe then indicated three ways of putting flange cores into place by means of templates. If this system were adopted it would only be very seldom that a core would be out of place.

In his contribution to the discussion it was not the making or the gating of pipes with which he was most concerned, but mainly to explain the occurrence of a waster pipe casting, 14 in. by 9 ft. long (Fig. 1), and which was a bad job owing to various reasons. First, the job was made as an ordinary pipe would be made, namely, horizontally using a top box only, the bottom being bedded in the floor. Naturally there would be a body core for the inner part of the mould. The fault lay in getting the particular mould ready; namely, by placing the body core into the bottom part of the mould with pieces of clay underneath it at both ends, with two other pieces on the top of the core. The top box was tried on. Then the pieces of clay under the body core showed the "metal" thicknesses in both the top and bottom halves of the mould. The top clays were ¼ in. and the bottom clays ¼ in. thick, so that the core was out of centre by ¼ in. This was where the mistake occurred, and where the make-up template was tried over the body core, the pieces of clay were useless and had merely a misleading effect.

When the foreman examined the clays he ordered the scotching of the core so that it would lift the core by ¼ in. when being cast. This was the snag, for when the core lifted, the metal obviously flowed into the space thereby created. This was precisely what happened, but the metal also ran into the core barrel causing the casting to be a waster. The barrel also had to be scrapped, thus the job turned out to be a costly one.

In his, Mr. Sutcliffe's, opinion, if the make-up had been used to centre the body core instead of proceeding in such a careless way the job would have been saved, and a good casting would have resulted. He had seen this mistake made quite often. Not very long ago he visited a foundry, and saw the very same thing occur, and there again metal entered the barrel. Clays and chaplets were not required when using a cast-iron core barrel in any straight-length pipe or cylinder cast on the flat if the end-bearings were correctly adjusted to the make-up. The make-up templates shown in Fig. 2 were very good. It was always possible to have the core in the centre by taking care and by using templates, He had brought with him some examples of templates which could be taken away by anyone who desired to make use of them.

### A Vacuum Cylinder Casting

Mr. Sutcliffe then mentioned another job with which he had been concerned, and an illustration (Fig. 3) of a vacuum cylinder was passed round for inspection. He also drew a diagrammatic sketch on the blackboard, saying that the casting would have been a waster if made up according to the suggestion of the leading draughtsman. Taking a sketch (Fig. 3) for a vacuum cylinder and then turning it down on its side, the pattern was split as shown in the dotted line of the sketch. The pattern was in two pieces, and the job was to be made on its side. He claimed that this way of making a vacuum cylinder was wrong. Chaplets would be required to hold the core in position if made from the pattern as prepared. He remembered a man putting a chaplet in the bore of a cylinder of a steam engine, but his own view was not to use chaplets in connection with machinery castings. He had seen hundreds of vacuum cylinders made without chaplets.

After having some conversation with the leading draughtsman, the pattern was sent back to the patternshop for alteration. The pattern was screwed together, loose pieces drawn in, while others were made fast and jointed down, so that the job could be made on end. The core then stood perpendicularly, and required neither studs nor chaplets. It turned out to be a very good casting and very satisfactory in the machine shop.

MR. COLLINS, referring to the running of pipes, asked whether the pipe was a long or a short one?

MR. SUTCLIFFE said that it had an overall length of 8 to 9 ft. This would not make any difference to the method or to the casting referred to.

MR. COLLINS thought any difficulty could be overcome by loaming up the ends. Some people made the core whilst leaving the hay-band showing at the end. He had had numerous cases where metal had entered the barrel, due to carelessness. Instead of loaming the core right up to the barrel, the straw was left showing, and metal had come underneath and had entered the barrel.

MR. SUTCLIFFE said that in reference to metal entering through the hay-band, it would not matter if the ends were made up completely. It was the lifting of the pipe barrel itself which left a vacant space, and the vacant space was filled with metal which was uncontrolled and entered the barrel. This answered the first point.

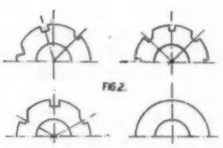



FIG. 2.—TEMPLATES.

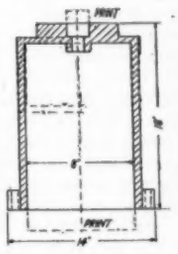



FIG. 3.—PATTERN FOR VACUUM CYLINDER.

MR. COLLINS asked what would be the position if the ends were scotched?

MR. SUTCLIFFE said that they were all scotched slackly, and allowed for the ¼ in. lift of the barrel.

MR. COLLINS remarked that the barrel would not lift at the end.

MR. SUTCLIFFE said that the ends were left with ¼ in. to lift.

### Use of Templates

MR. HILL, JUNR., suggested that if the chaplets were set correctly, there was no necessity for the template, and that it was merely making work.

MR. H. MORRIS, referring to the use of templates for flanges, said he used a special core box together with a block to form the flange and holes, which latter also served as a bearing for the core.

MR. SUTCLIFFE thought the blocks would be useless for jobbing work, of this kind and size. Chaplets were not the only means of keeping a core in the centre of a pipe. If a man were setting out to make a set of patterns for a pipe, namely, from a 2-in. or 3-in. pipe, and continued up to a 12-in. pipe, then if he would make a large quantity of flanges that would be quite satisfactory. He was speaking of jobbing, not of repetition work. One could not go into a jobbing foundry and make a pipe casting without a template, and make it satisfactorily.

### A Basic Principle for Running Pipes

The PRESIDENT said that every firm seemed to have a different method of running pipes. What was the main general jobbing principle?

MR. SUTCLIFFE said it all depended upon the foundry. One foundry ran a 6-in. pipe with two shanks, one at each end. It had to be carried from one end of the shop to the other, and one of the gates was on the flange and one on the body. Pipes withstood more pressure if run on the top than run underneath or on the joints. He did not believe in running pipes underneath at all. He counselled running them in a gate, for the simple reason that if the gate was knocked off there was porosity. He remembered once visiting a slipway foundry and remarking to the foreman that he would not run a particular pipe in such a manner. It was about 14 in. dia., and should have been run on the flange joint. There being a second one in the fettling shop, they asked for the runner to be knocked off, when porosity was revealed. In his, Mr. Sutcliffe's, opinion, if the casting was a straight length it could be run at the end, but this factor was governed to some extent by the section thickness. Pipes and tank plates were two of the worst things to tackle. He had recently cast a tank plate which was 7 ft. sq., the one it was replacing having been smashed, and well it might be, for it dated back for over 50 years judging by the firm's name embossed thereon.

### Pressure Resisting Castings

MR. A. HOPWOOD referred to pressure work, saying that it was possible to obtain a definite composition of cast iron by various means. One of these means, of course, was by the introduction of steel and modifying certain constituents by using suitable pig-iron. Another means to that end was the use of, he would not say fine iron, but of suitably graded scrap. Some founders were fortunate in having suitable scrap available. For compounding metal to a definite analysis, it was better to use graded scrap than to use mixed materials.

MR. SUTCLIFFE inquired whether Mr. Hopwood was referring to pipes cast on end.

MR. HOPWOOD said he was speaking about steam valves, etc., which were allied to the production of pressure type pipes.

### Delayed Testing Advocated

MR. SUTCLIFFE said steel would only close up the grain of the metal. If one could get all the metal into the mould, there would be nothing to worry about, but it might ooze out a little at the back of the flanges, and this would cause a defect.

Another point with pipes was that, if they were tested the same day as cast, the result given would operate against the foundry. If, however, they were allowed to lie in the yard for a day or two, an improvement would be shown. It was not wise to take castings straight out of the moulds and on to the testing machine.

MR. J. PELL, speaking with reference to leaking, inquired whether Mr. Sutcliffe had tried chilling or eliminating the riser on the top. Both methods had been used, and they had both proved successful.

MR. SUTCLIFFE said the portion of the casting showing defects was usually the top half of the flange as cast, the lower half invariably being sound.

### An Antique Flywheel Shaft

MR. H. HAYNES brought an illustration of a cast iron shaft 8 ft. long and 14 in. in diameter. He had the shaft broken up recently. It had carried a flywheel of 30 ft. diameter and weighing 30 tons; moreover, it had been working 100 years, and came from a mill in Guide Bridge. When it was broken, there was no sign of porosity, the casting being perfectly solid. It could be seen from the photographic illustration that the foreman, whoever he was, knew how to mix his metal.

Indicating the bar, Mr. Haynes said he did not know what corresponded to the Brinell test in the old days, but it did not appear as though the bar had worn ¼ in. in 100 years. It was made of exceedingly good material. To-day people talked about chilling, about shrinkage, and about porosity, etc.; and he congratulated the moulder upon his success in producing that bar.

MR. SUTCLIFFE pointed out that 44 years ago cam ends were chilled, as were all rods at the works with which he was associated, but it was wrong. They were just fed in a particular place where they were spongy.

MR. HAYNES said the centre had been keyed on. There was a slot where the key was inserted.

### Increasing Difficulties Surmounted

MR. NORMAN COOK, B.Sc., said it was only necessary to carry one's mind back to what happened 100 years ago, utilising cold blast irons made from Swedish ore. At the present time, owing to war conditions, there was a good deal of adulteration. The ore was melted, then remelted, and gradually became over-contaminated with sulphur. While giving all due credit to the foundryman of older days, he had not to contend with the obstacles that the present-day foundryman encountered. It was a matter of great credit to metallurgists throughout the country that they had been able to make such good castings with the material at their disposal.

### An Unbalanced Coupling

MR. HILL said he had attended a meeting of the branch some eight years ago, and the lecturer had brought an illustration of a big coupling which he said was destined for Russia. He could not get a truly balanced couple, and every time he broke it up the metal had proved to be porous. As he was taking the jib crane out of the yard one day, he found it had been weighted down with 40 tons of pig-iron. He used this pig-iron for couplings and they were good. When he had used up all his pig-iron the results were unsatisfactory.

### Shell-forming Dies

MR. POTTS said he had quite a simple job to do during the past few weeks. It was a plain block of cast iron, 13 in. dia., and roughly 15 in. in lenth. In it was the shape of a shell. It was used for pressing the final nose on to steel shells. It worked at about 2 tons per sq. in. It had been made outside previously, but there had been some difficulty about it; so he was asked if he could make one or two in order to facilitate production.

When he first got the job he thought there was nothing against casting it, by making use of a chill for the bore, and attaching a large feeding head of about 8 in. dia. The first casting was perfectly good on the outside, satisfactory in the bore, but the centre was porous. They were unable to obtain a good thread to hold it up into the press, and on account of this it was rejected.

He prepared another one in much the same way. He did not want to do any extensive chilling, but he did have the idea of making the casting with a small tapered chill by which he could guarantee a good hole. When the second one was cast it was quite good up to a point.

He mentioned that after it had done probably 5,000 or 6,000 operations it was taken away, and about three-quarters of an inch was machined off the depth. Therefore, another ¼ was taken off in the hole of the chill. This was done so that between 15,000 to 20,000 shells could be got out of the die. Another porous place occurred, so that instead of getting a third machining there were sometimes only two. Finally, he decided to chill the whole casting, and he made chills for the outside.

### Experience with Chills

He had had the idea the metal was either drawing away to the sides or that gas was being created from the chill; because when the chill had been used two or three times it became bellied on the top. It seemed to him that the chill was definitely softening, and that gas was being held at a certain point.

The last three castings were 2½ in. thick on the top, and at the moment they were doing fairly well; but he still could not understand why extensive chilling was necessary. He cast one, fed through a riser, and that also was porous in the hole. This was run in the bottom with a spiral runner.

It would be remembered that when Mr. McRae Smith delivered his lecture he mentioned that he had seen these dies cast in different ways. It would be recalled that he stated he had seen them cast from the top with small runners in a particular position. Quite frankly, he, the speaker, did not like that idea because he thought the metal would be falling on to the chill, and there would be trouble with the bore which did not occur at the moment, and this was the most important part of the die.

The first casting had the following analysis:—T.C, 3.21 per cent.; Si, 0.97; Mn, 0.64; S, 0.033, and P, 0.25 per cent. Two cast more recently gave the following analysis:—T.C, 3.31 per cent.; Si, 1.33; Mn, 0.43; S, 0.130; P, 0.41; Ni, 1.12, and Mo, 0.21 per cent.

What he wanted to know was whether there was any method of making these dies without extensive chills? The chills used had a total weight of about 3 cwt. 14 lbs., and the casting itself was 4½ lbs. Furthermore, he wanted some types of metal which would yield up to about 10,000 if he could get it. As was known, the constant re-heating of the shells caused little fissures to be created along the face of the die, which finally went out of shape. It had then to be taken away and re-bored. What he wanted was something to last a sufficient length of time to eliminate some of the machining. Furthermore, was he casting in the correct way, or was there some better method?

### Chills Essential

MR. E. LONGDEN said the firm with which he was associated happened to make the type of shell referred to, and the difficulty with which Mr. Potts had been troubled had been anticipated to some extent, though it persisted in various degrees for some time until the remedy for it was found. It would be remembered that Mr. McRae Smith, at the last meeting of the Branch, brought this particular question forward as a side-line from the analysis. This brought forward the question of chilling plus possibilities of overcoming all difficulties with the metal. With the particular type of casting concerned it was impossible to overcome the difficulty without chills, and Mr. McRae Smith had referred to the wonderful metals which were being produced to-day and the remarkable steps which were being taken in regard to the majority of cast irons. He then drew a section of the shell and explained how the difficulty was overcome.

The casting was run at the side, and then there would be heat generated on the chill. The chill was sharp, and one corner became overheated so that there were blow-holes round one area. The sharp corner was taken off, so that the mould at this point would not be rapidly overheated. There was a 1½ in. core. It was run with a series of sprays at the sides all the way round, so there was no part of the chill being exposed to the direct flow of the metal. After machining there was found to be an occasional blow-hole. A ring of chills was put round the area and 1 in. of solid round another point, and then the result was successful. The thickness of the chill was 2 in. There was just an ordinary self-feeder on the top.

### The 1914-1918 Method

MR. H. HAYNES said he had had some experience in running such castings during the last war. He ran the casting with a fountain runner at the bottom just as many jobs were done

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in Germany. He put the pressure on the mould and the runner, and let it come through from the top. There were no chills in. He put the pressure from the runners, left it open from the top, and all the gases escaped.

Mr. Haynes illustrated his meaning by means of a diagrammatic sketch on the blackboard.

MR. POTTS said that with the 8 in. feeding head the dies were cast open sand. The porosity occurred in the centre, and they could not get any thread in the hole which holds the die in the press. It was definitely porous, and they could not turn it up satisfactorily.

MR. E. LONGDEN remarked that with the method he had described there was not 1 per cent. wastage now. He thought it would be agreed that it was a successful way of casting, and he could recommend it.

MR. H. HAYNES said that the result of 1 per cent. admitted of no argument.

### Possibility of Compositional Control

MR. FLEMING thought there might be a danger, when casting a job in which one was dependent upon a chill for rapid cooling on the inside, that allowance would have to be made for the densening effect on the chill. It would be better to dispense with the densening altogether. If there was reliance placed merely on the metal composition for the property required, for instance, if chrome was added to stabilise carbides, he would not like to chill at the same time. He would sooner make the job entirely by normal methods and rely entirely on the metal properties, casting the job with a plain sand core as shown by Mr. Sutcliffe in an illustration during the course of which he remarked there was a certain amount of steel in the casting.

The PRESIDENT inquired whether Mr. Fleming was referring to the nosing die or the punching die.

MR. FLEMING said he was referring to the nosing die. Actually the problems were similar, only in one case a slab was put on just to take it off again. The trouble was in the slab and not in the job. He thought the mixing of two methods, one using metal composition and the other using chills, was rather dangerous. One or the other should be used entirely.

MR. POTTS said that if he could get a metal which would do away with the chills, he would not use them at all. If he could make a sound job with an analysis which would enable a chill to be used for a longer time, and give a longer life, that was all he really wanted.

### The Source of the Trouble

MR. LONGDEN said the question raised by Mr. Fleming was certainly interesting. If it was possible to secure soundness without the use of chills in the particular type of casting referred to, one would readily adopt the necessary method. But it must be understood, however, that all types of metal and sand were being used throughout the country, and this left something to be desired. The trouble arose from the overheating of a sand core, especially at the nose of the top end of the taper of the core. It could be visualised that the core was of a smaller diameter at the top end. The core became rapidly overheated, and from two points of view porosity occurred. In the first place, the core itself became rapidly overheated, and reached almost the temperature of the metal at the point of solidification. In addition, the grains of sand expanded very considerably, and even in spite of easy access to the vent, the gases were bubbling up from the core and disturbing the metal for some considerable time, until they found a route through the core as they ought to do. This effect of the core becoming overheated prevented the rapid solidification of the metal. The point at the nose of the core was the point at which the metal remained fluid longest. It would be recalled that Mr. McRae Smith pointed out that with that particular type of casting he could not guarantee soundness; in other words, just as with the material which had been developed, especially, for the purpose.

### Composition Queried

MR. BROOKS said that the analysis shown indicated an addition of nickel, with an increased amount of silicon, and the reverse order should rather apply, which might be somewhat helpful in that respect, namely, if the silicon was reduced when the nickel addition was made.

MR. LONGDEN said there was nothing to prevent a rearrangement of the analysis so as to accommodate chromium alloys. There would still be the heat-resisting properties imparted to the metals.

MR. FLEMING had the chromium base in mind.

MR. LONGDEN remarked that it would be found that the dies failed rather from abuse in handling by the people who used them at too low a temperature.

MR. POTTS had noticed there had not been sufficient temperature; but in his case he understood also that normally two operations were used. There was one, firstly, to take it down to a certain size, and then the final point had to be put on. At the moment, they only used one operation. Previously, they had only got 2,000 or 3,000 before distortion occurred, but at the present time they were getting between 3,000 and 5,000. He thought increased production could be had if there was a correct metal composition and a correct moulding procedure established.

MR. N. COOK said that, speaking generally with regard to the job under consideration, the service in his works was remarkably good. In regard to general production, he thought attention should be paid mainly to the temperature of the ovens in which there was the heating up of the nose of the shell. If this could be kept regular, it was astonishing what a tremendous number of shells could be got before there were any signs of wear or any crazing shown and when machining would be required. The main thing was to keep the oven at a regular temperature, because if there was failure in that respect, the whole job would be wrong.

MR. HOPWOOD wished to ask Mr. Potts a question with regard to the withdrawal of the solid chills from the bottom, and also with regard to the time which elapsed before he withdrew them. Did he let them become cold, or did he withdraw them at a definite temperature from the casting? Also, what protection did he put on to the chill to help to effect the withdrawal of the chill from the casting?

MR. POTTS had not experienced any trouble in taking out the chill recently. He had previously, but he found, after three or four had been cast, that softening took place on the top. He only casts twice with those chills, and there was no difficulty. He found that, if he left them until they were cold, they came out quite easily, needing merely a tap or two. A plumbago wash was used, and there was no trouble with the chill at all.

MR. LONGDEN said it would be found that the steel chill came out better than the cast iron one, which would soften at a lower temperature. Although both had been used, his experience was that the steel chill was far better and certainly could be knocked out when the casting was cold. When trying to knock a chill out hot, it would be bulged up and break.

With regard to the dies, a combination was necessary. There should be no moisture present. They were not cast with the mould hot, because the chill was already heated, but cast as cold as possible without moisture having been condensed at the chill.

The discusssion then terminated.

## American Standard Alloy Steel Listed

To increase efficiency in production of steel by encouraging a reduction in the number of kinds of steel ordered, the American Iron and Steel Institute has selected a list of 76 standard alloy steels, after a two-year study of the needs of consumers. If production can be concentrated on those standard steels, it is hoped to expedite deliveries and make possible many other advantages for buyers as well as for producers of alloy steels. At the same time the effectiveness of research work on steel should be greatly increased, advances should be made in manufacturing methods, and service to consumers should be improved.

The study made showed that out of the thousands of varieties of alloy steels produced each year, a relatively few accounted for the bulk of the tonnage. In 1940, approximately 96 per cent. of the total output of tonnage alloy steels was accounted for by only 55 different varieties. Standardisation is expected to reduce the unnecessarily wide range of specifications during the defence emergency.

It is noted that the study was prompted by the growing variety of chemical compositions and quality requirements of steel consumers in recent years. This trend has been a matter of concern to steel producers, because it increased manufacturing difficulties and slowed down production. In most cases, consumers can use the standard steels to replace many of the similar non-standard grades now being used, without changing their manufacturing methods or impairing the quality of the article manufactured.

The committee has taken as standards the ranges and limits of composition which have been widely used by steel producers and consumers in recent years for the various alloying elements, such as nickel, molybdenum and chromium. The list of standard steels is largely based on these standard ranges and limits. Alloy steels other than the listed standard steels may occasionally be required by consumers for specialised uses. Specifications for such non-standard steels will continue to be based on the standard ranges and limits of composition.

## U.S. Iron and Steel Output

Operating at the equivalent of 100 per cent. of rated capacity, the United States steel industry in March produced 7,146,372 net tons of steel, a new high record, reports the American Iron and Steel Institute. March output was 14 per cent. above the 6,250,413 tons produced in February and 42 per cent. greater than the 4,390,090 tons made in March, 1940. First quarter production this year reached a new peak of 20,339,869 tons, an average of 98 per cent. of capacity. This figure is almost 40 per cent. above that for the first quarter of 1940, when production was 14,685,960 tons.

Production of pig-iron during March totalled 4,704,135 net tons, the highest monthly output on record and compares with the previous record of 4,663,695 net tons in January last. March output compares with 4,197,872 tons in the short month of February and 3,270,499 and 2,681,969 net tons in March, 1940 and 1939, respectively. Production in the first quarter of the current year aggregated 13,565,702 net tons, against 10,604,001 tons in the parallel 1940 period. On April 1, there were 205 furnaces in operation, against 202 in blast on March 1.

Finished steel produced for sale in February totalled 4,864,936 net tons, only 298,976 tons less than in January, despite the shorter month. Sheets represented the most active products, output at 1,093,293 tons being 107.3 per cent. of capacity. In the classification "all other" products the percentage was 135.7 per cent. Other high rates were shown in cold-rolled strip, 86.6; cold-reduced tinplate, 81; drawn wire, 91.4; mechanical tubing, 92.1; bars, 87.4; plates, 88.1; and structural shapes, 81.1 per cent. Exports accounted for 11.5 per cent. of output in February, being only half the share taken in the peak month of August last.

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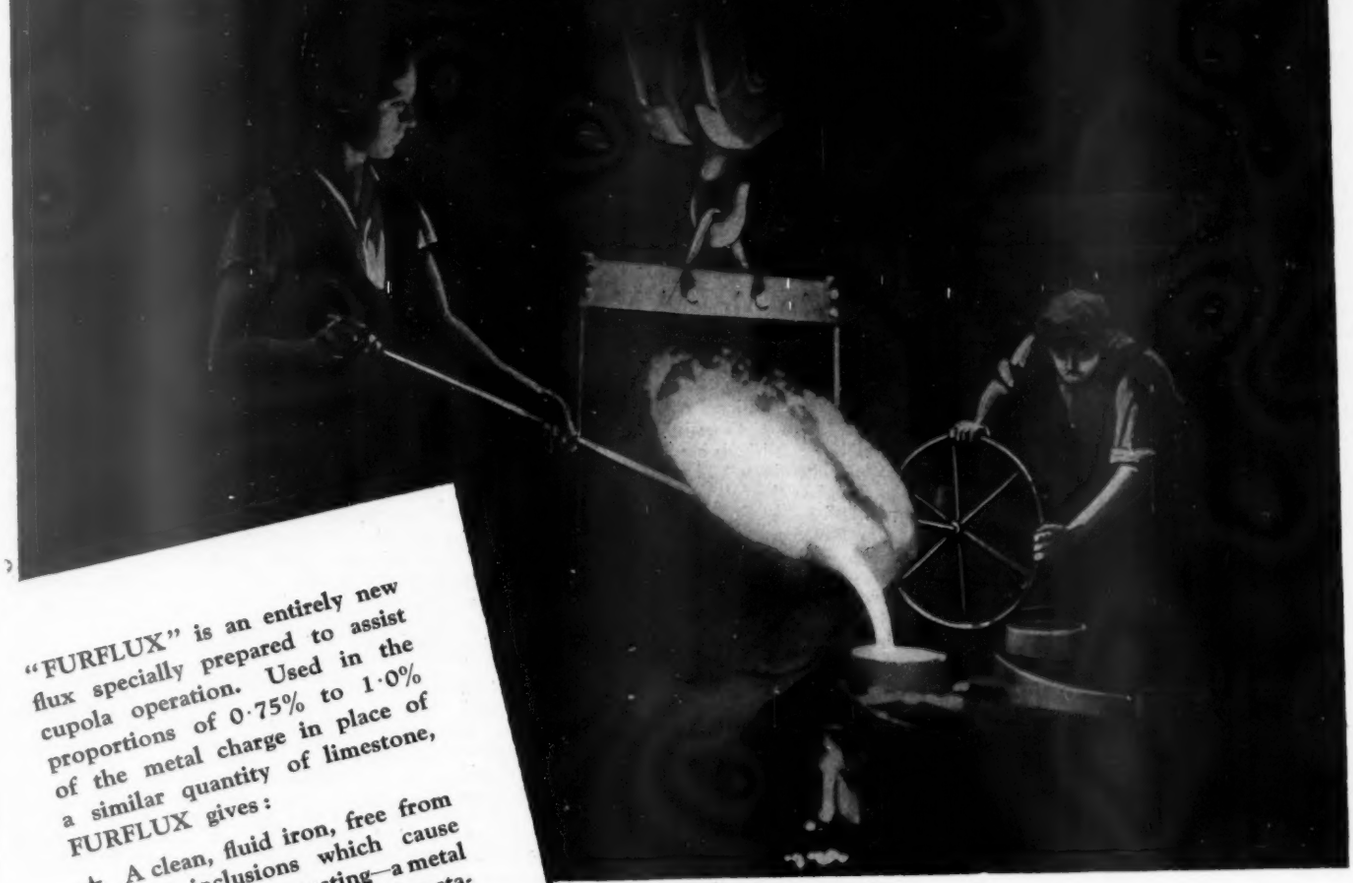

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# De-Oxidation in the Foundry Cupola

BY W. MCCONNACHIE.

It has usually been taken for granted and quite recently considered as proved beyond question, that, in the hot zones of the cupola, the conditions are strongly oxidising. Fletcher's experiments, as also those of Belden (of the U.S.A. Bureau of Mines) show large percentages of free oxygen, and of $CO_2$ at some considerable height above tuyere level, vertically over the tuyere mouth—and a typical analysis of the gases escaping at the charging hole of a large cupola, working on long period melts, shows, according to Fletcher, a content of $CO_2$, 18.5; CO, 1.4; $O_2$, 0.6, and $N_2$, 79.5 per cent., by volume. Working this out for the ratio of oxygen to nitrogen it gives 19.8 vols. $O_2$ with 79.5 vols. $N_2$; or 23.27 vols. of $O_2$ per 100 vols. $N_2$. As the blast in average conditions may be taken as containing 26.5 volts. of $O_2$ per 100 of $N_2$, this seems to add support to the hypothesis, in that it shows conclusively that part of the oxygen of the blast has been rendered non-gaseous in passing through the combustion zone.

Indeed, the industry has been warned, that the higher temperature and the better conditions at times obtained by altering tuyere arrangements, with notable economy in the coke consumed, *may* have been obtained through the burning (and consequent loss) of steel—more expensive than coke.

It would seem that the metallurgist will require to modify his views radically. Simultaneously with the oxidation of metal there occurs a large amount of reduction, which is proved conclusively by a study of the composition of the cupola slags, and their weight, in relation to that of the metal obtained. Chiefly noticeable is the ratio of the iron and manganese content.

*Analyses of Slag from Cupola.*

| | Metal for Tropenas (80 per cent. low carbon steel scrap). | | Foundry iron; 10 per cent. steel scrap general castings |
|---|---|---|---|
| | I. | II. | |
| Silica .. .. | 47.62 | 49.38 | 44.5 |
| Lime .. .. | 11.95 | 11.35 | 13.7 |
| Manganese (Mn) .. | 7.10 | 5.76 | 5.77 |
| Iron (Fe) .. .. | 4.59 | 3.08 | 5.05 |
| Sulphur .. .. | 0.073 | 0.085 | 0.025 |
| | No receiver in use. | | Receiver used. |

Those analyses show quite clearly that the whole of the manganese oxide charged as such in the "rust" or pig-iron "skin," or formed by the oxidising blast, is retained in the slag, while by far the greater proportion of the iron oxide, similarly charged, or produced, is reduced to the state of metal, and so recovered.

Since there must be at least 90 times the weight of iron oxide to 1 of manganese oxide, whether charged in the "rust," etc., or simultaneously produced, it seems evident that the particular agent which removes the oxygen from the iron oxide is without action on the oxide of manganese, unless such manganese, in presence of excess iron oxide, became manganese oxide, by taking oxygen from the iron.

The blast oxygen fixed by the silicon burned out, is very small in amount, as is also that fixed by the manganese. Further, a considerable amount of oxygen is contributed by the rust and scale on the materials charged, which is not associated with nitrogen.

The carbonic acid from the limestone used is a further source of oxygen, so increasing the ratio of oxygen to nitrogen beyond the average of 26.5 vols. of oxygen per 100 vols. of nitrogen in the blast. The writer is driven to the conclusion that the figures given by Fletcher as the typical composition of the cupola gases at charging door level may be rather misleading. The missing oxygen *must* be in the gases at *the temperature of that level.* Since no mention is made of the sulphur gases, it is evident that the analysis given is not complete. Water vapour is not mentioned, but may be most important. Since comparatively little sulphur is picked up by the metal, and there is very little in the slags (although the slags cited contain much manganese) the bulk of the sulphur of the coke must be in an oxidised gaseous form. The moisture of the blast will most likely be decomposed at first, then reformed, and go out as it entered.

It would seem probable that quite a lot of reduction may be effected by direct contact of the oxides with the hot carbon of the coke below tuyere level. As, however, one gets results generally similar from a cupola in which the melt just passes through such coke into a receiver, the author is inclined to think that some more active agent is at work. Now the only agents at all likely to operate are the strongly reducing gases expelled from good foundry coke when highly heated.

In some cases such gases contain as much as 0.5 per cent. by weight of the coke, of hydrogen, with 3 times as much in hydrocarbons, etc.

The quantity of coke used per ton of metal charged (when working with large percentages of low carbon steel scrap) contains sufficient hydrogen to take the oxygen from three-quarters of a cwt. of ferrous oxide. The hydrocarbon associated and expelled with the hydrogen may also help in the reduction.

To ascertain exactly *where* this reduction takes place in the cupola, it will be of considerable help to have analyses of the gases at various points on a radius *between* the tuyeres—and at different levels.

Moreover, it would be imperative to have a *complete* analysis of the exit gases, carefully sampled, at the level of the charging mouth before contamination with air. The subject is of much practical importance, as slags could be adjusted and smelted to recover the useful manganese they contain.

# An Estimation of Silicon in Monel Metal

MR. F. B. CLARDY, MR. H. R. MAUPIN and MR. R. S. GIBBS have collaborated in a Paper entitled "Determination of Silicon in Monel Metal, Copper-Silicon Alloys and Similar Non-Ferrous Alloys Containing Silicon." It was originally published in "Industrial and Engineering Chemistry" (Anal. Edn.), and has been abstracted in the following terms by the "Nickel Bulletin."

The Paper contains a description of a method developed by the United States Navy Yard, Portsmouth, Va., which is claimed to eliminate the disadvantages of procedure involving dehydration by nitric-sulphuric acids or by hydrochloric acid and potassium chlorate, and to give accurate results in 2 to 3 hrs. The new method also obviates the bumping which occurs when the metal is first dissolved in nitric acid and then fumed with perchloric acid.

Details of recommended procedure are:—Weigh 2 grms. of fine drillings into a 400-ml. Pyrex beaker, add 25 ml. of 70 per cent. perchloric acid and 1 ml. of concentrated nitric acid, place the beaker on a hot plate and heat until solution of metal is complete. Add a few more drops of nitric acid, if necessary, to ensure complete solution. Place the beaker on an extremely hot electric or gas plate and boil the solution for about 10 min., to ensure the complete dehydration of silica. Towards the end of this period, the beaker may be heated over an open gas flame, the contents of the beaker being slowly revolved. Cool slightly, add water, and heat until all soluble salts are dissolved, boiling the solution at the end. Filter hot through a Whatman No. 41 H, or similar filter paper. Wash five times alternately with a solution containing a mixture of 1 per cent. nitric acid and 1 per cent. hydrogen peroxide, and with boiling water.

Remove filtrate for the subsequent determination of other elements and wash the silica residue with hot 10 per cent. hydrochloric acid and boiling water alternately five times and then with water, until free from acid. Place filter paper in a 30-ml. platinum crucible, ignite, cool and weigh. Volatilise the silica with hydrofluoric acid plus three drops of sulphuric acid, ignite again, cool and re-weigh. The loss in weight is silica ($SiO_2$). The residue remaining in the crucible will consist of traces of nickel, iron and titanium. This can be fused with pyrosulphate, dissolved in water, and added to the filtrate. Some platinum will be introduced during this fusion and will be subsequently deposited with the copper and weighed as such. This has been found to be extremely small and in routine analysis can be disregarded. The filtrate from the silicon determination can be used for the determination of copper, iron and titanium by the following procedure:—

Boil the filtrate strongly to remove free chlorine and add 1 ml. of concentrated nitric acid and 5 ml. of concentrated sulphuric acid. Keep the volume of solution at approximately 300 ml. Electroplate copper on the platinum cathode at 0.5 amp. and 3 volts. After copper is removed, make the solution weakly ammoniacal, and determine iron and titanium in the usual manner. Excess ammonia will form a precipitate with perchloric acid.

TABLE I.—*Determination of Silicon.*

| | Perchloric-Nitric Acid. Per cent. | Sulphuric-Nitric Acid. Per cent. | Hydrochloric Acid-Potassium Chloride. Per cent. |
|---|---|---|---|
| Sample 1 | 3.02–3.03 | 2.99–3.01 | 3.07–3.10 |
| Sample 2 | 1.49–1.49 | 1.50–1.46 | 1.48–1.46 |
| Sample 3 | 3.08–3.09 | 3.04–3.19 | 3.08–3.12 |

Table I gives results, by three methods, for determining silicon in samples of Monel. In each instance the filtrates were evaporated to dryness twice, to recover silica. No silica was found in the filtrates from the perchloric-nitric acid treatment. In the other two cases, sufficient silica was found to make these evaporations necessary.

**Bott, Bot or Bod?**

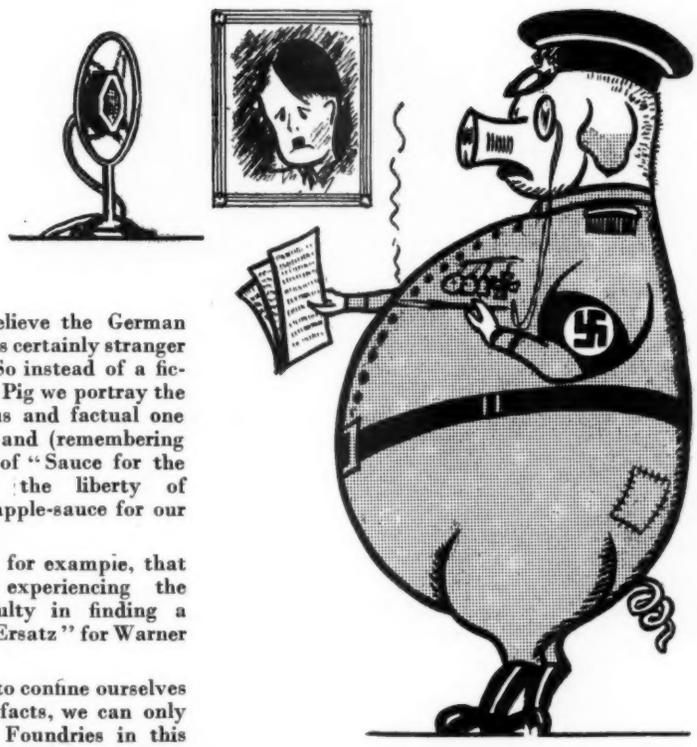
Practical foundrymen are found to use all three forms of spelling, and both pronunciations. The first is the correct word, and probably comes from a French word, botte, a clod of earth which adheres to the hoof of an animal. Both the French and Germans use the equivalent of the word "cork"—"bouchon" and "Stopfen" or "Ton-stopfen."

**Gas Evolved from Cores**

A useful article has been contributed to "The Foundry" by H. W. Dietert, in which he shows that by increasing the baking temperature from 175 deg. C. to 230 deg. C. the gas content of comparable cores was reduced from 17 to 12.8 ml. He also showed that fine-grained cores carry a much higher gas content, when baked at 205 deg. C., than coarser material. The reduction in gas content is gained at some loss of tensile strength.

W

# "Jairmany Calling ...."



If we are to believe the German wireless, truth is certainly stranger than fiction. So instead of a fictitious Warner Pig we portray the *really* humorous and factual one from Bremen, and (remembering the old adage of "Sauce for the Goose") take the liberty of borrowing his apple-sauce for our impropaganda.

We might say, for exampie, that Germany is experiencing the greatest difficulty in finding a satisfactory "Ersatz" for Warner Pig Iron.

But, if we are to confine ourselves to established facts, we can only tell you that Foundries in this country are specifically calling for Warner Pig Iron, and that, knowing the destination of many of their products, we are supplying it to our usual standard, but with more than our usual satisfaction.

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# The Week's News in Brief

## Trade Talk

GASKELL & CHAMBERS, LIMITED, brassfounders, etc., have moved into temporary offices at Gazette Buildings, Corporation Street, Birmingham.

OWING TO ENEMY ACTION, Lavino (London), Limited, have moved from 29, Mincing Lane, E.C.3, to 103, Kingsway, W.C.2, to which address all inquiries should be sent.

THE IRON TRADES EMPLOYERS' INSURANCE ASSOCIATION announces that Mr. J. Reid-Young, C.A., F.C.I.S., director of Vickers, Limited, and associated companies, has joined its board.

BUICK, OLDS & CADILLAC are replacing aluminium piston rings by tinplated iron castings, the electroplating equipment for which is on order. Additional moulding plant has also been requisitioned.

THE HARD METAL MANUFACTURING COMPANY, LIMITED, is being wound up voluntarily. Sir Alan Rae Smith, of Deloitte, Plender, Griffiths & Company, 5, London Wall Buildings, E.C.2, is the liquidator.

THE FORTH & CLYDE STEEL FOUNDRY (1932), LIMITED, one of the best-known firms in the Scottish trade, has drawn attention to the fact that they are definitely not in liquidation and that a notice referring to the liquidation of the Forth & Clyde Steel Foundry, Limited (in liquidation), does not refer to them.

A MEETING OF THE LONDON SECTION of the Institute of Metals will be held at the Junior Institution of Engineers (Incorporated), 39, Victoria Street, Westminster, S.W.1, on Thursday, June 19, at 6.30 p.m., when Mr. F. A. Fox, M.Sc., will deliver an address on "The Production and Properties of Magnesium Alloys."

AT THE ANNUAL GENERAL MEETING of the Institute of Physics held on June 4, the following were elected to take office on October 1, 1941: President, Prof. Sir Lawrence Bragg; vice-president, Prof. W. Makower; hon. treasurer, Major C. E. S. Phillips; hon. secretary, Prof. J. A. Crowther; ordinary members of the board, Prof. J. Chadwick and Mr. D. C. Gall.

THE PARTNERSHIP between Messrs. John William Roberts, Walter Howard, Frederick Bardsley, and James Arthur Owens, carrying on business as sheet metal workers at Bennett Street, Stalybridge, under the style of the Grosvenor Sheet Metal Company, has been dissolved by mutual consent so far as concerns Mr. James Arthur Owens. Debts will be received and paid by the remaining partners, who are continuing the business.

THE MACHINERY, PLANT AND APPLIANCES (CONTROL) NO. 3 ORDER, dated June 3, 1941 (S.R. & O. 1941 No. 778, price 1d.), provides that the acquisition and supply of such woodworking machinery and plant as is subject to the control of the Ministry of Supply (Machine Tool Control) shall no longer be subject to licence by the Board of Trade (Industrial Supplies Department, Machinery Licences Division, 1-6, Tavistock Square, London, W.C.1).

A RECORD MEMBERSHIP OF 13,000 is expected to be obtained soon by the United Patternmakers' Association. Mr. Alan Findlay, general secretary, reports a total of 12,749, the peak figure in the history of the Association and an increase of 85 over the report the previous month. There are 676 members on superannuation and 290 on the sick-list. The executive is inviting nominations for the position of general secretary and financial secretary. Voting on the nominations will take place at the June meetings.

DOMESTIC HEATING APPLIANCES.—With reference to Press Notice dated February 8, 1941 (No. 24), it is to be noted that water jackets for the type of domestic heating apparatus commonly known as the independent domestic boiler are chargeable under Class 7. Ash pans, fire bricks, grate bars, and hob bars for such apparatus are chargeable under Class 9. With reference to the second paragraph on page 18 of Notice No. 78 relating to "firebricks and cheeks of fire brick or metals," linings for cylindrical slow combustion stoves of sizes up to and including 30 in. high by 12 in. in diameter, external measurements, fall to be charged under this heading.

MR. GEORGE WOOD, Director of Scrap Supplies at the Iron and Steel Control, stated in an interview that the stocks of scrap iron and steel at the furnaces were at least 50 per cent. higher than they were 12 months ago, but he emphasised the necessity of ensuring that the flow of all types of scrap from every possible direction is kept up and no potential source neglected. Every corporation, council, company, and individual must be encouraged to contribute to the utmost of their powers to maintain the supply, he pointed out, and any expression of opinion to the contrary should be disregarded. On the other hand, it was important to remember that the material collected might not be wanted for immediate use. Long views must be taken and provision made months in advance for supplies to be available. It should, therefore, not be assumed that the situation was not fully in hand because collected stocks were in evidence at various points up and down the country.

GENERAL LICENCE FOR TEMPORARY SUPPLY OF MACHINERY, PLANT AND APPLIANCES.—Under Statutory Rules and Orders 1941, No. 777, which came into force on June 3, 1941, a general licence is issued authorising and permitting any manufacturer to supply to any person carrying on a business in which machinery, plant or appliances of a kind specified in the Schedules to the Machinery and Plant (Control) No. 2 Order 1940 (S.R. & O. 1940 No. 1363) or the Machinery, Plant and Appliances (Control) Order 1940 (S.R. & O. 1940 No. 2179) are used, and such person to accept, machinery, plant, or appliances of the description so used in temporary substitution for goods so used while the latter are undergoing repair or reconditioning, or are being replaced by other similar goods. This licence is issued subject to certain conditions specified in the Order. Any inquiries necessary should be addressed to the Industrial Supplies Department (Machinery Licences Division), Board of Trade, 1-6, Tavistock Square, London, W.C.1.

## Personal

MR. B. B. KENT, well known in vitreous enamelling and foundry circles, has severed his connections with the Sterling Manufacturing Company of London, of which concern he was general manager.

MR. LEE C. WILSON, of Reading, Pa., general manager of the Reading Steel Casting Division of the American Chain & Cable Company, Inc., Bridgeport, Conn., is this year's recipient of the Frederick A. Lorenz Medal of the Steel Founders' Society of America.

COMMANDER SIR CHARLES CRAVEN has been elected president of the British Employers' Confederation for the ensuing year. The Confederation is the national organisation for dealing with general labour questions on behalf of employers. Sir Charles Craven is the chairman and managing director of Vickers-Armstrongs, Limited, and other companies and is a past-president of the Engineering and Allied Employers' National Federation.

MR. H. E. G. WEST has been appointed managing director of Newton Chambers & Company, Limited, for the purpose of co-ordinating their extensive coal-mining, foundry, engineering, coal-distillation, and chemical operations. Mr. West, now general manager of the firm's chemical works, joined the company 22 years ago from the Contracts Department of the War Office, to which he was transferred after being seriously wounded in France in 1917. Mr. West has for many years been a prominent figure in the colliery and chemical industries and has served on many committees formed to promote research into coal chemistry and to develop the marketing of colliery products. The office of managing director of this old and famous firm has been in abeyance since the death in 1934 of Mr. W. Newton Drew, who combined it with that of chairman of the company. The present chairman is Sir Samuel Roberts, Bt.

MR. DONALD J. REESE, recently awarded the J. H. Whiting Gold Medal of the American Foundrymen's Association, was born in Wilkes-Barre, Pa., and received his earlier education at the Boys' High School, Reading, Pa. His first position was that of chemist for McCord & Company, Chicago. Later he accepted a similar position with the Wilson Foundry & Machine Company, Pontiac, Mich., and in 1920 became associated with the Whiting Corporation. After a year of service, he obtained leave of absence to complete a technical course at the University of Michigan, Ann Arbor, Mich., from which he was graduated in 1925 with a degree of Bachelor of Science in chemical engineering. Returning to the Whiting Corporation, he was made foundry engineer and later foundry superintendent, serving in that capacity until 1926, when be became metallurgist, Grindle Fuel Equipment Division of that firm. He retained that position until 1928, when he was transferred to the firm's Chicago office for a year, and then returned to the plant to engage in sales engineering work. He recently accepted his present position as foundry research engineer, Research and Development Division, International Nickel Company, New York City. Mr. Reese has written numerous technical articles, and is an active member of the A.F.A. and the American Society for Metals. In connection with the A.F.A. he has a unique record in that he was the first chairman of the Chicago Chapter of A.F.A., this being the first chapter organised. He was also the first chairman of the Metropolitan Chapter. In his efforts to be helpful to foundrymen he has addressed practically every chapter of the Association, and in many cases has been a repeat speaker before these groups. His particular field of development has been that of improvement of cupola melting of cast iron, in which he has made an outstanding reputation.

## Obituary

MR. FRED THOMPSON, who had 50 years' service with Newton, Chambers & Company, Limited, in the light-castings department, Thorncliffe, died on May 27.

MR. A. R. H. JACKSON, chief engineer and a director of Erskine, Heap & Company, Limited, manufacturing electrical engineers, of Salford, died on May 27. Mr. Jackson was in his 65th year and was educated in Liverpool. He joined the General Electric Company as a premium apprentice in 1898. On the foundation of Erskine, Heap & Company in 1905 Mr. Jackson joined the firm as chief draughtsman, rising later to be chief engineer. In 1939 he was made a director of the company.

## New Companies

*(From the Register compiled by Jordan & Sons, Limited, Company Registration Agents, 116 to 118, Chancery Lane, London, W.C.2.)*

**High Duty Saws, Limited,** Bissell Street, Quinton, Birmingham—Capital, £2,000.

**Carlier Bros., Limited,** Duffield Road, Little Eaton, Derby—Capital, £1,000. Founders, engineers, etc.

**Alston Foundry Company, Limited**—Capital, £100. Subscriber: J. C. Arnott, "Blairgowrie," Dalton-le-Dale, Co. Durham.

**Manchester Diecasting Company, Limited**—Capital, £1,000. Directors: H. M. Freckleton and W. J. Baker, 19, Headlands Drive, Prestwich, Manchester.

## Contract Open

**Birmingham,** June 25—Supply and erection of a stationary (200 cub. ft. per min.) motor-driven air compressor, air receiver, incidental pipe work, etc., for the Electricity Committee. Mr. F. Forrest, chief engineer and manager, 14, Dale End, Birmingham, 4. (Fee £2, returnable.)

## Reports and Dividends

**R. A. Lister & Company, Limited**—Interim dividend of 5 per cent. (same).

**J. Brockhouse & Company, Limited**—Ordinary interim dividend of 7½ per cent.

**National Electric Construction Company, Limited**—Dividend of 10 per cent. (same).

**Siemens Bros. & Company, Limited**—Ordinary dividend of 7½ per cent. for 1940 (same).

**Bradley & Foster, Limited**—Final dividend of 6 per cent., making 10 per cent. (8 per cent.), plus a cash bonus of 2½ per cent. (2 per cent.).

**Tweedales & Smalley (1920), Limited**—Final dividend of 10 per cent., making 12½ per cent. for the year to April 30 (against 10 per cent. for 1939-40).

**R. W. Crabtree & Sons, Limited**—Net profit for 1940, after taxation, £41,398 (against £69,510 for 1939); dividend of 8 per cent. on the ordinary shares (same).

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***Further information will be sent on request.***

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# Raw Material Markets

The iron and steel industries are working under fairly stable conditions, in so far that all classes of consumers have knowledge of the treatment they can expect to receive at the hands of the Control authorities, while producers know, too, what is expected of them. Thus, there are now fewer instances of applications being made for iron and steel for non-essential consumption, as buyers appreciate that they stand little chance, generally speaking, of obtaining material. No change in iron and steel prices has been made since November last, but since that time costs of production have increased, and it is felt that the introduction of higher selling prices may not be long delayed, though it is the avowed policy of the authorities to avoid inflation of prices.

## Pig-Iron

**MIDDLESBROUGH**—Iron consumers in this area continue to make applications for substantial tonnages of better quality material, due to the fact that by far the most active section is the heavy engineering trade. Light-castings foundries are still unable to operate their plant to anything like full capacity, and have no difficulty in procuring high-phosphorus iron for makers in the Midlands. Foundry iron production in the Cleveland district is almost non-existent, local furnaces having to give their full attention to the needs of the steelworks. No high hopes of any material expansion in working conditions among light foundries are expressed, as the main supports of this trade, the building industry and foreign buyers, are not likely to place orders of any magnitude, while not many foundries have been drawn into war production as yet.

It is thought possible that some expansion may shortly be made in hematite production in this area; at present, only high-priority users are allowed to purchase hematite, and even to satisfy their needs it is necessary to utilise imported iron. The Control has quite considerable stocks of foreign iron, but, in view of the desirability of conserving shipping space, future overseas purchases will be strictly confined to urgent requirements.

**LANCASHIRE**—There is only a moderate demand for pig-iron from the light-castings trade, while many jobbing foundries also are making comparatively small calls on production. The latter, generally, cannot see far ahead, but some works have quite good order-books extending over a short period. Iron consumption among specialised engineering works, however, is at peak levels, with every prospect of a continuance of active conditions for a long time to come. Special refined grades of iron are being taken up in good tonnages.

**MIDLANDS**—The light foundry trade is still in need of orders, and very few works can see far ahead. A small volume of Government contracts has been circulated in the industry, but the amount of work of national importance so far offered to the light foundries has been very disappointing. The demand for light castings from home consumers is anything but active, while export business is curtailed by Government restrictions and other difficulties, so that it may be said that the future of the industry depends on the extent to which Government departments can utilise the products of the works. Substantial pressure continues to be made on heavy engineers, who are participating fully in the defence programme. Unlike the light foundry trade, which uses high-phosphorus iron, speciality engineers, mainly require low-phosphorus iron and hematite, both of which are produced from imported ores. These better quality irons are now very difficult to obtain and, in fact, the Control authorities are endeavouring to restrict consumption as far as possible, as home outputs cannot look after all demands, recourse having to be made to foreign iron. Considerable progress has been made in the efforts to encourage users to adapt their mixtures, and in this connection quite appreciable tonnages of high-phosphorus iron, refined qualities, and steel scrap are being utilised.

**SCOTLAND**—Slow deliveries of pig-iron continue to be reported at some receiving centres, but it is satisfactory that no essential users are going short as far as their current requirements are concerned, although the present position does not facilitate the building up of reserve stocks, which would be of considerable benefit as a precaution against future interrupted deliveries which may occur. Consumption among heavy engineering works is on a very large scale, but the call for foundry iron from makers of light castings does not involve particularly extensive quantities, owing to the poor state of consumers' order-books. Iron for the latter is being obtained from the English Midlands, regular despatches being made.

## Coke

As stated last week, the price of foundry coke has been increased by the Control by 1s. 3d. per ton, the current price for delivery to Birmingham and Black Country stations being 62s. 9d. for Durham best fuel. The higher quotation was introduced following an increase in the price of coal, and had been generally expected. Stocks of coke at the ovens are quite large, and regular deliveries are being made under contracts, many consumers taking advantage of the position to augment their own reserves.

## Steel

Since the last advance was made in steel selling prices there has been a further increase in costs of production, and it would appear likely that some account will shortly be taken of this by the Control, as the margin between steelmakers' costs and selling prices has been narrowed appreciably of late. Descriptions of steel required for Government contracts continue to be strongly called for, with the result that producers cannot take on orders except those bearing high-priority licences. Many steelworks are well committed into the third quarter of the year. The output of special qualities of steel is being enlarged, and it is certain that consumption of these grades will rise still further.

## Scrap

The relation between supply and the demand for iron and steel scrap has lately improved, and both steelworks and foundries are getting larger tonnages. Despite the more satisfactory conditions at present prevailing, no relaxation can be allowed in the collection of fresh supplies, as stocks at consuming points remain far below what is necessary to ensure a continuous flow of metal to the furnaces. Steelmakers, especially, are willing to accept delivery of much larger quantities than are currently forthcoming. The improvement in deliveries is not confined to one or two particular areas, but is general throughout the country.

## Metals

**COPPER** — Considerable economy is being effected in the civilian consumption of copper in the United States; producers there are to reserve 20 per cent. of their output for the requirements of national defence orders, and priority restrictions are being imposed on the distribution of the remaining 80 per cent. Scrap copper is not included in the priority arrangements. Mr. F. H. Brownell, chairman of the American Smelting & Refining Company, speaking at the annual meeting of the company recently, said that the bottleneck in copper was mine production, whereas in zinc it was smelter capacity. He did not think a higher copper selling price would appreciably increase copper mine output, but added that some expansion from existing properties might result through the payment of higher wages and overtime.

In this country demand for copper for meeting Government contracts is maintained at a very high level, and urgent calls for supplies are being satisfied promptly. Licences are granted only sparingly for ordinary domestic consumption.

**TIN**—A questionnaire sent out recently by the Ministry of Supply to certain firms regarding tin stocks was followed by a meeting on Friday of the London Metal Exchange, which decided to ask the Ministry for the reasons for the questionnaire before replying to it. The questionnaire asks, *inter alia*, what stocks of tin are held by various firms; what are the reasons for holding them; to whom a sale is proposed; and where the supplies are situated. Doubt was expressed in market circles whether an immediate reply could fairly be demanded to the questions, since only certain firms have been asked to fill in the form.

Dealings in tin on the London Metal Exchange during the past few days improved, and the tone of the market became firmer, despite the embargo on the export of tin from the United Kingdom. Tin is involved in the trade negotiations between Japan and the Dutch East Indies; the D.E.I. is believed to be insisting that Japan should give a guarantee against the reshipment of commodities to Germany.

There was an increase in the total visible supply of zinc in May, according to the statistics prepared by Mr. W. H. Gartsen (Henry Rogers, Sons & Company). The total on May 31 was 37,191 tons, as compared with 35,086 tons a month earlier. The carry-over in the Straits Settlements amounted to 2,400 (1,961) tons, while the carry-over at principal European smelters was 1,594 (2,098) tons. Deliveries of tin in May totalled 13,944 tons, against 16,871 tons in April, and were made up as follow:—United Kingdom, 836 (954); Continent, except Holland, 500 (nil); United States, 10,490 (13,955); other countries, 2,118 (1,962) tons. A. Strauss & Company state that consumption in the United Kingdom is now about 10 per cent. less than the average of last year. While more tin is being used in the production of war materials, this has not fully compensated for the drop in consumption caused by the elimination of non-essential goods, various restriction orders and the fall in export trade.

Tin deliveries to the American Metals Reserve Company, which were to have amounted to 75,000 tons by June 30, according to specified plans, are not now expected to exceed by more than 1,000 tons or so the figure of 35,000 tons by that date. Open purchases by the company by the end of June will be about 21,000 tons, which will absorb all the surplus supplies for the subsequent five months. It follows that there will be no tin during that period available for sale to that body deliverable before December. Thus, there is no likelihood of the spot price falling below 50 cents during the remainder of the year.

Tin prices on the London Metal Exchange during the past week have been as follow:—

*Cash*—Thursday, £266 5s. to £266 10s.; Friday, £268 5s. to £268 10s.; Monday, £268 10s. to £268 15s.; Tuesday, £266 to £266 5s.; Wednesday, £266 to £266 5s.

*Three Months*—Thursday, £266 to £266 5s.; Friday, £268 5s. to £268 10s.; Monday, £269 to £269 5s.; Tuesday, £266 15s. to £267; Wednesday, £267 to £267 5s.

**SPELTER**—The tightening up of the control of zinc has been accentuated of late, and non-essential users of the metal are now finding it harder than ever to acquire their full needs. The Control authorities are running no risks, and are taking all steps necessary to ensure a regular flow of spelter to factories engaged on vital operations.

**LEAD**—Good quantities of lead are being absorbed by the war machine, but other users are by no means neglected. Cable and battery makers' requirements are at a particularly high level. According to the American Bureau of Metal Statistics, domestic stocks of refined lead at the end of April totalled 42,900 short tons, against 46,000 tons on March 31 and 63,610 tons on April 30, 1940. Production in April was 56,100 tons, against 61,500 tons in March, while deliveries were 59,200 tons, compared with 62,100 tons.

### Nickel-Manganese Rolling-Mill Gears

In some American rolling mills there is a tendency to substitute 4 per cent. nickel-manganese steel for standard manganese steel for mill gearing, especially for the table gears. The standard manganese steel is stated by Mr. J. A. Brandenburg, of the American Brake Shoe & Foundry Company, to suffer somewhat on account of the rough heat-treatment it gets, through heating up to shrink the castings on to the shaft. Nickel-manganese steel will return to a satisfactory, tough, austenitic state even after heating up to a temperature of 1,035 deg. C.

FOR WORKING TO MACHINE SHOP TOLERANCES

Machine shops will not tolerate wide margins in castings.

STERNOCORE High Efficiency Core Oils, Creams and Compounds are great aids to working to these exacting standards.

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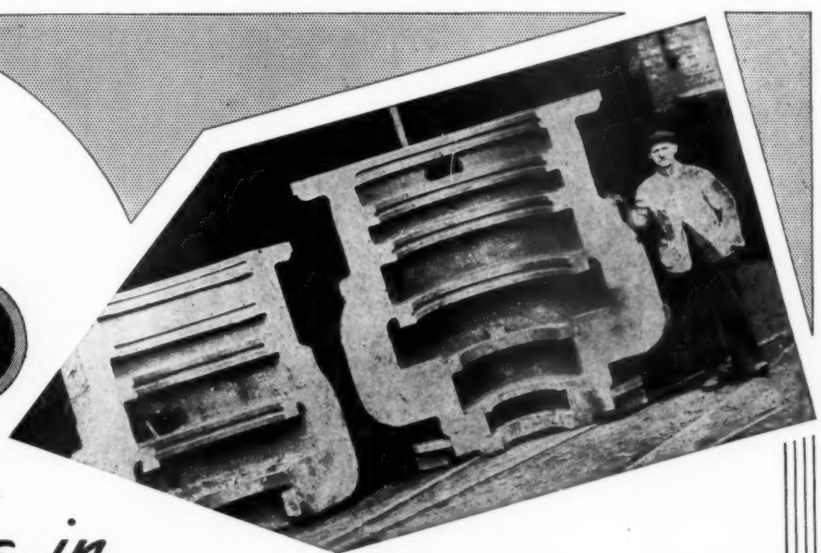

STEEL CASTINGS

From a few ounces up to 25 TONS

*FOR ALL INDUSTRIES*

JAMES BRIDGE STEEL WORKS near WEDNESBURY

PHONE DARLASTON 225 (3 lines)
GRAMS STEEL DARLASTON

# RAW MATERIALS—PRICE LIST

## Wednesday, June 11, 1941

### COPPER*

| | £ | s. | d. |
|---|---|---|---|
| Electrolytic .. .. | 62 | 0 | 0 |
| High-grade fire-refined .. | 61 | 10 | 0 |
| Fire-refined of not less than 99.7 per cent. .. .. | 61 | 0 | 0 |
| Do., do., 99.2 per cent. .. | 60 | 10 | 0 |
| Black hot-rolled wire rods.. | 65 | 10 | 0 |

### TIN

| | | | |
|---|---|---|---|
| Standard cash .. .. | 266 | 0 | 0 |
| Three months .. .. | 267 | 0 | 0 |
| Settlement .. .. .. | 266 | 5 | 0 |
| Official average Cash, June | 267 | 13 | $11\frac{5}{11}$ |
| Do. Three Months, June | 266 | 8 | $11\frac{5}{11}$ |
| Do. Settlement, June .. | 267 | 14 | $3\frac{9}{11}$ |

### SPELTER*

| | | | |
|---|---|---|---|
| G.O.B. (foreign) (duty paid) | 25 | 15 | 0 |
| Do. (domestic) .. .. | 26 | 10 | 0 |
| " Prime Western " .. .. | 26 | 10 | 0 |
| Refined and electrolytic .. | 27 | 5 | 0 |
| Not less than 99.99 per cent. .. .. .. | 28 | 15 | 0 |

### LEAD*

| | | | |
|---|---|---|---|
| Good soft pig-lead (foreign) (duty paid) .. .. | 25 | 0 | 0 |
| Do., do., (Empire and domestic) .. .. .. | 25 | 0 | 0 |
| English .. .. .. | 26 | 10 | 0 |
| Sheets, home .. .. | 35 | 10 | 0 |
| Do. export, f.o.b. .. | 31 | 0 | 0 |
| Pipes, home .. .. .. | 35 | 0 | 0 |
| Do. export, f.o.b. .. | 31 | 10 | 0 |
| Tea lead (nom.) .. .. | | — | |

### ALUMINIUM

| | | | |
|---|---|---|---|
| Ingots .. .. .. | 110 | 0 | 0 |
| Wire, 10g. .. .. .. | | .. nom. | |
| Sheets .. .. .. | | .. nom. | |
| Circles, 20/24g. .. .. | | .. nom. | |

### ZINC SHEETS, etc.

| | | | |
|---|---|---|---|
| Sheets, 10g. and thicker, ex works .. .. .. | 39 | 2 | 6 |
| Rolled zinc (boiler plates), ex works .. .. .. | 37 | 2 | 6 |
| Zinc oxide (Red Seal), d/d buyers' premises .. .. | 28 | 7 | 6 |

### ANTIMONY

| | | | |
|---|---|---|---|
| English, 99%, delivered .. | 102 | 10 | 0 |
| Foreign Regulus, duty paid .. .. .. | 93 | 0 | 0 |
| Chinese, prompt shipment, c.i.f. .. .. .. | | nom. | |

### QUICKSILVER

| | | | |
|---|---|---|---|
| Quicksilver, ex w'hse London | 47 | 15 | 0 |

### HIGH-SPEED TOOL STEEL

| | |
|---|---|
| Finished bars, 14% tungsten | 3s. 0d. |
| Finished bars, 18% tungsten | 3s. 10d. |
| Finished bars, 22% tungsten | 4s. 4d. |

Per lb. d/d buyers' works.

### NICKEL SILVER, etc.

| | Per lb. |
|---|---|
| Ingots for raising .. | 10d. to 1/4 |
| Rolled— | |
| To 9 in. wide .. | 1/4 to 1/10 |
| To 12 in. wide .. | 1/4½ to 1/10½ |
| To 15 in. wide .. | 1/4½ to 1/10½ |
| To 18 in. wide .. | 1/5 to 1/11 |
| To 21 in. wide .. | 1/5½ to 1/11½ |
| To 25 in. wide .. | 1/6 to 2/– |
| Ingots for spoons and forks | 10d. to 1/6½ |
| Ingots rolled to spoon size | 1/1 to 1/9½ |
| Wire round— | |
| To 10g. .. .. | 1/7½ to 2/2½ |

with extras according to gauge.

Special 5ths quality turning rods in straight lengths, 1/6½ upwards.

* Maximum prices per long ton delivered to buyers' premises.

### FERRO-ALLOYS AND STEEL-MAKING METALS

| | | | |
|---|---|---|---|
| Ferro-silicon (5-ton lots)— | £ | s. | d. |
| 25% .. .. .. | 21 | 0 | 0 |
| 45% .. .. .. | 23 | 10 | 0 |
| 75% .. .. .. | 36 | 10 | 0 |
| Ferro-vanadium— | | | |
| 35/50% .. .. .. | 15/6 lb. Va. | | |
| Ferro-molybdenum— | | | |
| 70/75% carbon-free .. | 6/– lb. Mo. | | |
| Ferro-titanium— | | | |
| 20/25% carbon-free .. | 1/9 lb. | | |
| Ferro-tungsten— | | | |
| 80/85% .. .. .. | 5/1 lb. | | |
| Tungsten metal powder— | | | |
| 98/99% .. .. .. | 5/2½ lb. | | |
| Ferro-chrome— | | | |
| 2/4% car. .. .. | — | | |
| 4/6% car. .. .. | 47 | 0 | 0 |
| 6/8% car. .. .. | 47 | 0 | 0 |
| 8/10% car. .. .. | — | | |
| Ferro-chrome— | | | |
| Max. 2% car. .. .. | 1/0¾ lb. | | |
| Max. 1% car. .. .. | 1/1½ lb. | | |
| Max. 0.5% car... .. | 1/1¾ lb. | | |
| 70% carbon-free .. | — | | |
| Nickel—99.5/100% .. | £190 to £195 | | |
| " F " nickel shot .. .. | 175 | 0 | 0 |
| Ferro-cobalt, 98/99% .. | 8/9 lb. | | |
| Metallic chromium— | | | |
| 96/98% .. .. .. | 3/9 lb. | | |
| Ferro-manganese— | | | |
| 76/80% loose .. .. | 18 | 10 | 0 |
| 76/80% packed .. .. | 20 | 0 | 0 |
| Metallic manganese— | | | |
| 94/96% carbon-free .. | 1/9 lb. | | |

Per ton unless otherwise stated, basis 2-ton lots, d/d Sheffield works.

### SCRAP*

| | £ | s. | d. | | £ | s. | d. |
|---|---|---|---|---|---|---|---|
| SOUTH WALES— | | | | | | | |
| Short heavy steel, not ex. 24-in. lengths .. | 4 | 2 | 0 | to | 4 | 4 | 6 |
| Heavy machinery cast iron .. .. | | | 4 | | 7 | | 0 |
| Ordinary heavy cast iron .. .. | | | 4 | | 2 | | 0 |
| Cast-iron railway chairs .. .. .. | | | 4 | | 7 | | 0 |
| Medium cast iron .. | | | 3 | | 18 | | 3 |
| Light cast iron .. .. | | | 3 | | 13 | | 6 |
| MIDDLESBROUGH— | | | | | | | |
| Short heavy steel | 3 | 19 | 9 | to | 4 | 2 | 3 |
| Heavy machinery cast iron .. .. | | | 4 | | 11 | | 9 |
| Ordinary heavy cast iron .. .. | | | 4 | | 9 | | 3 |
| Cast-iron railway chairs .. .. .. | | | 4 | | 9 | | 3 |
| Medium cast iron .. | | | 3 | | 19 | | 6 |
| Light cast iron .. .. | | | 3 | | 14 | | 6 |
| BIRMINGHAM DISTRICT— | | | | | | | |
| Short heavy steel | 3 | 14 | 9 | to | 3 | 17 | 3 |
| Heavy machinery cast iron .. .. | | | 4 | | 12 | | 3 |
| Ordinary heavy cast iron .. .. | | | 4 | | 7 | | 6 |
| Cast-iron railway chairs .. .. .. | | | 4 | | 7 | | 6 |
| Medium cast iron .. | | | 4 | | 0 | | 3 |
| Light cast iron .. .. | | | 3 | | 15 | | 3 |
| SCOTLAND— | | | | | | | |
| Short heavy steel | 3 | 19 | 6 | to | 4 | 2 | 0 |
| Heavy machinery cast iron .. .. | | | 4 | | 14 | | 3 |
| Ordinary heavy cast iron .. .. | | | 4 | | 9 | | 3 |
| Cast-iron railway chairs .. .. .. | | | 4 | | 14 | | 3 |
| Medium cast iron .. | | | 3 | | 17 | | 3 |
| Light cast iron .. .. | | | 3 | | 12 | | 3 |

* Delivered free to consumers' works in England and Wales. For deliveries of cast-iron scrap free to consumers' works in Scotland, the above prices less 3s. per ton, but plus actual cost of transport or 6s. per ton, whichever is the less. All prices: Plus 3½ per cent. dealers' remuneration: 50 tons and upwards over three months 2s. 6d. extra.

### PIG-IRON*

| | |
|---|---|
| N.E. COAST (d/d Tees-side area)— | |
| Foundry No. 1 .. .. | 131/– |
| " No. 3 .. .. | 128/– |
| " No. 4 .. .. | 127/– |
| Forge No. 4 .. .. | 127/– |
| Hematite No. 1 .. .. | 138/6 |
| Hematite M/Nos. .. .. | 138/– |
| N.W. COAST— | |
| Hem. M/Nos. d/d Glasgow | 138/6 |
| " d/d Birmingham .. | 150/– |
| MIDLANDS (d/d Birmingham dist.)— | |
| Staffs No. 4 forge .. .. | 129/– |
| " No. 3 fdry. .. .. | 130/– |
| Northants forge .. .. | 126/6 |
| " fdry. No. 3 .. | 127/6 |
| " fdry. No. 1 .. | 130/6 |
| Derbyshire forge .. .. | 129/– |
| " fdry. No. 3 .. | 130/– |
| " fdry. No. 1 .. | 133/– |
| Phosphorus 0.5% to 0.75% | 137/6 |
| Phosphorus 0.1% to 0.5% | 140/6 |
| SCOTLAND— | |
| Foundry No. 1, Grangemouth | 127/3 |
| " No. 3, Grangemouth | 124/9 |
| Cleveland No. 3, Glasgow.. | 131/– |
| " " Falkirk .. | 128/– |
| Scottish hem. M/Nos. d/d.. | 138/6 |
| SHEFFIELD (d/d district)— | |
| Derby forge .. .. | 126/6 |
| " fdry. No. 3 .. | 127/6 |
| Lincs forge .. .. | 126/6 |
| " fdry. No. 3 .. .. | 127/6 |
| W.C. hematite .. .. | 144/– |
| LANCASHIRE (d/d eq. Man.)— | |
| Derby fdry. No. 3 .. | 133/– |
| Staffs fdry. No. 3 .. .. | 133/– |
| Northants fdry. No. 3 .. | 131/6 |
| Cleveland fdry. No. 3 .. | 133/– |
| *Cylinder and Refined Irons.* | |
| North Zone.. .. .. | 174/– |
| South Zone.. .. .. | 176/6 |
| *Refined Malleable.* | |
| Birmingham and S. Staffs | 171/6 |
| *Cold Blast.* | |
| South Staffs .. .. | 220/6 |

* Prices of hematite and basic pig-iron, and of foundry and forge iron with a phosphoric content of not less than 0.75 per cent., are subject to a rebate of 5s. per ton under certain conditions.

### SEMI-FINISHED STEEL

*Re-rolling Billets, Blooms and Slabs.*

| | £ | s. | d. |
|---|---|---|---|
| BASIC: | | | |
| Soft, u.t., 100-ton lots .. | 12 | 5 | 0 |
| Tested, up to 0.25% C. .. | 12 | 10 | 0 |
| Tested, 0.25 to 0.33% C. | 12 | 12 | 6 |
| Tested, 0.33 to 0.41% C. | 12 | 15 | 0 |
| Hard (0.42 to 0.60% C.) .. | 13 | 17 | 6 |
| " (0.61 to 0.85% C.) .. | 14 | 7 | 6 |
| " (0.86 to 0.99% C.) .. | 14 | 17 | 6 |
| " (1% C. and up) .. | 15 | 7 | 6 |
| Silico-manganese .. .. | 16 | 5 | 0 |
| Free-cutting .. .. | 14 | 10 | 0 |
| SIEMENS MARTIN ACID: | | | |
| Up to 0.25% C. .. .. | 15 | 15 | 0 |
| Case-hardening .. .. | 16 | 12 | 6 |
| Silico-manganese .. .. | 16 | 5 | 0 |

*Billets, Blooms and Slabs for Forging and Stamping.*

| | | | |
|---|---|---|---|
| Basic soft, up to 0.25% C. .. | 13 | 17 | 6 |
| Basic hard, 0.41 to 0.60% C. | 14 | 10 | 0 |
| Acid, up to 0.25% C. .. | 16 | 5 | 0 |

*Other Semi-products, etc.*

| | | | |
|---|---|---|---|
| Tin bars .. .. .. | 12 | 2 | 6 |
| Sheet bars .. .. .. | 12 | 2 | 6 |
| *Wire rods, soft basic .. | 17 | 7 | 6 |
| " hard basic .. | 21 | 2 | 6 |
| " free-cutting .. | 20 | 2 | 6 |
| " acid .. .. | 24 | 13 | 6 |

* Subject to rebate.

### FINISHED STEEL

*Usual district deliveries.*

[A rebate of 15/- per ton for steel bars, sections, plates, joists and hoops is obtainable in the home trade under certain conditions.]

| | £ | s. | d. |
|---|---|---|---|
| Plates, ship (N.E. Coast).. | 16 | 3 | 0 |
| Boiler plts. (N.E. Coast) .. | 17 | 0 | 6 |
| Chequer plts. (N.E. Coast) | 17 | 13 | 0 |
| Angles, over 4 un. ins. .. | 15 | 8 | 0 |
| Tees, over 4 un. ins. .. | 16 | 8 | 0 |
| Joists, 3 in. × 3 in. and up | 15 | 8 | 0 |
| Rounds and squares, 3 in. to 5½ in. .. .. .. | 16 | 8 | 0 |
| Rounds under 3 in. to ⅝ in. (untested) .. .. | 17 | 12 | 0 |
| Flats—over 5 in. wide .. | 15 | 13 | 0 |
| " 5 in. wide and under .. | 17 | 12 | 0 |
| Rails, heavy, f.o.t. .. | 14 | 10 | 6 |
| Hoops .. .. .. | 18 | 7 | 0 |
| Black sheets, 24 g. (4-t. lots) | 22 | 15 | 0 |
| Galv. cor. shts. ( " ) | 26 | 2 | 6 |
| Galv. flat shts. ( " ) | 26 | 12 | 6 |
| Galv. fencing wire, 8g. plain | 28 | 17 | 6 |

### FINISHED IRON

| | £ | s. | d |
|---|---|---|---|
| CROWN IRON: | | | |
| England and Wales .. | 15 | 12 | 6 |
| Scotland .. .. .. | 15 | 12 | 6 |
| Ireland, f.o.q. .. .. | 16 | 5 | 0 |
| No. 3 BARS: | | | |
| England and Wales .. | 12 | 10 | 0 |
| Scotland .. .. .. | 13 | 12 | 6 |
| Ireland, f.o.q. .. .. | 13 | 2 | 6 |
| No. 4 BARS: | | | |
| England and Wales .. | 13 | 0 | 0 |
| Scotland .. .. .. | 13 | 17 | 6 |
| Ireland, f.o.q. .. .. | 13 | 12 | 6 |
| STRIP: | | | |
| England and Wales .. | 17 | 0 | 0 |
| STAFFS MARKED BARS, f.o.t... | 18 | 10 | 0 |

### AMERICAN IRON AND STEEL

At Pittsburgh unless otherwise stated.

(April 29, 1941)

| | Dols. |
|---|---|
| No. 2 foundry, Phila. .. .. | 25.84 |
| No. 2 foundry, Valley .. .. | 24.00 |
| No. 2 foundry, Birm. .. .. | 19.38 |
| Basic, Valley .. .. .. | 23.50 |
| Malleable, Valley.. .. .. | 24.00 |
| Grey forge, Valley .. .. | 23.50 |
| Ferro-mang., seaboard .. .. | 120.00 |
| O.-h. rails, h'y, at mill .. .. | 40.00 |
| Billets .. .. .. .. | 34.00 |
| Sheet bars.. .. .. .. | 34.00 |
| | Cents |
| Iron bars, Chicago .. .. | 2.25 |
| Steel bars .. .. .. | 2.15 |
| Tank plates .. .. .. | 2.10 |
| Beams, etc. .. .. .. | 2.10 |
| Wire rods .. .. .. | 2.00 |
| Skelp, grooved steel .. .. | 1.90 |
| Steel strip .. .. .. | 2.10 |
| Steel sheets .. .. .. | 2.10 |
| Sheets, galv., 24 g. .. .. | 3.50 |
| Wire nails .. .. .. | 2.55 |
| Plain wire .. .. .. | 2.60 |
| Tinplates, 100-lb. box .. .. | $5.90 |

### COKE (at ovens)

| | |
|---|---|
| Welsh foundry .. .. | 48/9 to 50/3 |
| " furnace .. .. | 36/9 to 38/9 |
| Durham foundry .. .. | 46/9 |
| " furnace .. .. .. | 35/6 |
| Scottish foundry.. .. | 47/3 to 52/3 |
| " furnace .. .. .. | 35/6 |

### TINPLATES

| | | | |
|---|---|---|---|
| I.C. cokes | 20 × 14 per box | .. | 30/9 |
| " | 28 × 20 " | .. | 61/6 |
| " | 20 × 10 " | .. | 44/3 |
| " | 18¾ × 14 " | .. | 32/– |
| C.W. " | 20 × 14 " | .. | 28/6 |
| " | 28 × 20 " | .. | 57/– |
| " | 20 × 10 " | | 36/9 to 38/9 |
| " | 18¾ × 14 " | | 30/– to 30/6 |

## NON-FERROUS SCRAP

(Official Maximum Prices, per ton ex Works.)

| | £ | s. | d. |
|---|---|---|---|
| Bright untinned copper wire, in crucible form or in hanks | 57 | 10 | 0 |
| No. 1 copper wire | 57 | 0 | 0 |
| No. 2 copper wire | 55 | 10 | 0 |
| Copper firebox plates, cut up | 57 | 10 | 0 |
| Clean untinned copper, cut up | 56 | 10 | 0 |
| Braziery copper | 53 | 10 | 0 |
| Q.F. process and shell-case brass, 70/30 quality, free from primers | 49 | 0 | 0 |
| Clean fired 303 S.A. cartridge cases | 47 | 0 | 0 |
| 70/30 turnings, clean and baled | 43 | 0 | 0 |
| Brass swarf, clean, free from iron and commercially dry | 34 | 10 | 0 |
| New brass rod ends, 60/40 quality | 38 | 10 | 0 |
| Hot stampings and fuse metal, 60/40 quality | 38 | 10 | 0 |
| Admiralty gunmetal, 88-10-2, containing not more than ¼ per cent. lead or 3 per cent. zinc, or less than 9½ per cent. tin | 72 | 0 | 0 |

| NEW BRASS TUBES, etc. | Per lb. |
|---|---|
| Solid drawn tubes | 13¾d. |
| Brazed tubes | 15¾d. |
| Rods, drawn | 11¼d. |
| Rods, extd. or rlld. | 8¼d. |
| Sheets to 10 w.g. | 10⅝d. |
| Wire | 10¾d. |
| Rolled metal | 10d. |
| Yellow metal rods | 8¼d. |

| COPPER TUBES, etc. | |
|---|---|
| Solid drawn tubes | 15d. |
| Brazed tubes | 15d. |
| Wire | 9¾d. |

| PHOSPHOR BRONZE | Per lb. basis |
|---|---|
| Strip | 13¼d. |
| Sheet to 10 w.g. | 14¼d. |
| Wire | 15¼d. |
| Rods | 15¼d. |
| Tubes | 21d. |
| Castings | 17d. |

Delivery 3 cwt. free.
10% phos. cop. £35 above B.S.
15% phos. cop. £40 above B.S.
Phosphor tin (5%) £40 above price of English ingots.
C. CLIFFORD & SON, LIMITED.

## A COMPARISON OF SCRAP PRICES

*Average Delivered Prices of Heavy Steel Scrap (large quantities) in the Principal Districts at the Beginning of Each Month in the Years* 1934–1941.

| Year. | January. | February. | March. | April. | May. | June. | July. | August. | September. | October. | November. | December. | Yearly average. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | £ s. d. | £ s. d. | £ s. d. | £ s. d. | £ s. d. | £ s. d. | £ s. d. | £ s. d. | £ s. d. | £ s. d. | £ s. d. | £ s. d. | £ s. d. |
| *Scotland—* | | | | | | | | | | | | | |
| 1934 | 2 8 9 | 2 14 3 | 2 13 0 | 2 13 0 | 2 12 0 | 2 10 0 | 2 10 6 | 2 10 6 | 2 11 0 | 2 10 9 | 2 10 0 | 2 8 9 | 2 0 7¾ |
| 1935 | 2 10 0 | 2 10 0 | 2 10 0 | 2 10 0 | 2 10 0 | 2 10 0 | 2 10 0 | 2 10 0 | 2 10 0 | 2 10 0 | 2 10 0 | 2 10 0 | 2 11 2 |
| 1936 | 2 12 6 | 2 17 6 | 2 17 6 | 2 17 6 | 2 17 6 | 2 17 6 | 2 17 6 | 2 17 6 | 2 17 6 | 2 17 6 | 2 17 6 | 2 17 6 | 2 17 1 |
| 1937 | 2 17 6 | 3 2 6 | 3 6 0 | 3 5 9 | 3 5 9 | 3 5 9 | 3 5 9 | 3 5 9 | 3 5 9 | 3 5 9 | 3 6 3 | 3 6 3 | 3 4 9¾ |
| 1938 | 3 6 3 | 3 6 3 | 3 6 3 | 3 6 3 | 3 6 3 | 3 6 3 | 3 6 3 | 3 6 3 | 3 6 3 | 3 6 3 | 3 6 3 | 3 6 3 | 3 6 3 |
| 1939 | 2 17 9 | 2 17 9 | 2 17 9 | 2 17 9 | 2 17 9 | 2 17 9 | 2 17 9 | 2 17 9 | 2 17 9 | 2 19 0 | 2 19 0 | 2 19 0 | 2 18 0¾ |
| 1940 | 2 19 0 | 2 19 0 | 3 9 0 | 3 9 0 | 3 9 0 | 3 9 9 | 3 9 9 | 3 9 9 | 3 9 9 | 3 9 9 | 3 9 9 | 3 9 9 | 3 7 9¼ |
| 1941 | 3 10 3 | 3 10 3 | 3 10 3 | 3 10 3 | 3 10 3 | 3 10 3 | — | — | — | — | — | — | — |
| *North-East Coast—* | | | | | | | | | | | | | |
| 1934 | 2 10 0 | 2 16 0 | 2 10 0 | 2 7 6 | 2 7 6 | 2 10 0 | 2 9 9 | 2 10 0 | 2 10 0 | 2 10 0 | 2 11 6 | 2 11 3 | 2 10 3½ |
| 1935 | 2 11 6 | 2 11 9 | 2 12 0 | 2 12 0 | 2 12 6 | 2 12 6 | 2 12 6 | 2 12 6 | 2 12 6 | 2 12 6 | 2 12 6 | 2 13 9 | 2 12 4½ |
| 1936 | 2 15 0 | 2 17 6 | 2 17 6 | 2 17 6 | 2 17 6 | 2 17 6 | 2 17 6 | 2 17 6 | 2 17 6 | 2 17 6 | 3 0 0 | 3 0 0 | 2 17 8½ |
| 1937 | 3 2 6 | 3 5 0 | 3 7 0 | 3 7 9 | 3 7 9 | 3 7 9 | 3 7 9 | 3 7 9 | 3 7 9 | 3 7 9 | 3 8 3 | 3 8 3 | 3 7 1½ |
| 1938 | 3 8 3 | 3 8 3 | 3 8 3 | 3 8 3 | 3 8 3 | 3 8 3 | 3 8 3 | 3 8 3 | 3 8 3 | 3 8 3 | 3 8 3 | 3 8 3 | 3 8 3 |
| 1939 | 2 19 9 | 2 19 9 | 2 19 9 | 2 19 9 | 2 19 9 | 2 19 9 | 2 19 9 | 2 19 9 | 2 19 9 | 3 1 0 | 3 1 0 | 3 1 0 | 3 0 0½ |
| 1940 | 3 1 0 | 3 1 0 | 3 11 0 | 3 11 0 | 3 11 0 | 3 11 9 | 3 11 9 | 3 11 9 | 3 11 9 | 3 11 9 | 3 11 9 | 3 11 9 | 3 9 9¼ |
| 1941 | 3 12 3 | 3 12 3 | 3 12 3 | 3 12 3 | 3 12 3 | 3 12 3 | — | — | — | — | — | — | — |
| *South Wales—* | | | | | | | | | | | | | |
| 1934 | 2 10 0 | 2 16 3 | 2 15 9 | 2 13 9 | 2 14 3 | 2 15 0 | 2 14 3 | 2 14 3 | 2 15 0 | 2 15 6 | 2 15 6 | 2 15 6 | 2 14 7 |
| 1935 | 2 15 6 | 2 15 6 | 2 15 6 | 2 15 6 | 2 15 6 | 2 15 6 | 2 15 6 | 2 15 6 | 2 16 1½ | 2 17 9 | 2 19 8 | 3 1 1½ | 2 16 2½ |
| 1936 | 3 2 6 | 3 5 0 | 3 5 0 | 3 5 0 | 3 5 0 | 3 5 0 | 3 3 0 | 3 2 0 | 3 2 0 | 3 4 0 | 3 4 0 | 3 4 0 | 3 3 10½ |
| 1937 | 3 5 0 | 3 10 0 | 3 10 0 | 3 8 9 | 3 8 9 | 3 8 9 | 3 8 9 | 3 8 9 | 3 8 9 | 3 9 9 | 3 9 9 | 3 9 9 | 3 14 7½ |
| 1938 | 3 10 0 | 3 10 0 | 3 10 0 | 3 10 0 | 3 10 0 | 3 10 0 | 3 10 0 | 3 10 0 | 3 10 0 | 3 10 0 | 3 10 0 | 3 10 0 | 3 10 0 |
| 1939 | 3 1 6 | 3 1 6 | 3 1 6 | 3 1 6 | 3 1 6 | 3 1 6 | 3 1 6 | 3 1 6 | 3 1 6 | 3 1 6 | 3 1 6 | 3 1 6 | 3 1 6 |
| 1940 | 3 1 9 | 3 1 9 | 3 11 9 | 3 11 9 | 3 11 9 | 3 12 9 | 3 12 9 | 3 12 9 | 3 12 9 | 3 12 9 | 3 12 9 | 3 12 9 | 3 10 8 |
| 1941 | 3 13 4½ | 3 13 4½ | 3 13 4½ | 3 13 4½ | 3 13 4½ | 3 13 4½ | — | — | — | — | — | — | — |


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Instructions for these advertisements, accompanied by a remittance, are accepted up to FIRST POST WEDNESDAY MORNING for insertion in the current week's issue. All communications to be addressed to the Advertisement Manager, FOUNDRY TRADE JOURNAL, 3, Amersham Road, High Wycombe, Bucks. The Proprietors reserve the right to refuse any advertisement they consider unsuitable.

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